AGRICULTURAL ENGINEERING

AUGUST 1943

THE JOURNAL OF THE AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS

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AGRICULTURAL ENGINEERING

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Vol. 24, No. 8

EDITORIAL

Steel vs. Stoop

SELDOM is there such striking contrast between the philosophies of engineered abundance and of socialized scarcity as are revealed in the article on sugar beet production which begins on the page opposite. It deserves study by Messrs. Steinbeck, Weiner, et al.

All the agitation along social and political lines never increased by a pound per acre the amount of sugar which a man's labor would produce, nor by a penny per hour the value of his social contribution. Either the remuneration of the worker had to remain low, or the price of sugar had to go up. Either way, the conditions of his work were those of galling drudgery. Either way, the problems of peak labor loads and the evils of migrant labor were not mitigated.

As compared with the mechanized methods described by Roy Bainer, the traditional hand operations of blocking and thinning take eleven times too much labor, and bring no better return in tonnage per acre. Since hand or "stoop" labor is largely the limiting factor in beet sugar production under present conditions of sugar rationing and manpower shortage, the significance of this engineered development in the battle of food can hardly be overemphasized.

Considering the complexities involved, this advance in the art of sugar growing has been almost revolutionary in the swiftness of its coming. Yet, though begun in years of depression and labor surpluses, it is coming to fruition barely in time to be of help during war shortage and war need. It shows the wisdom, even the necessity, of pushing forward with research and development regardless of momentary circumstances.

This advance also exemplifies the essential contribution of every element in the profession of agricultural engineering. Federal agencies, state experiment stations, and private industry all have participated, and progress has been faster for the peculiar part each has played. Perhaps the American Society of Agricultural Engineers can claim some credit for having facilitated their cooperation.

In one respect this sugar-beet development has been exceptional. It has required less than the usual degree of collaboration with other branches of agricultural science. Usually there are interlockings with agronomy, plant breeding, animal husbandry, etc., to a far greater extent. As we note the exception we emphasize the rule, and renew our determination to work hand in hand with those other branches of agricultural advancement.

Against Gagging

BEFORE their so-called feud is forgotten, let us declare our dissent from the abuse, official and otherwise, heaped upon Messrs. Wallace and Jones because they allowed their differences to go before the court of public opinion. However much we may criticize their respective views and policies, we are bound to admire their devotion to duty and their courage of conviction, their instinctive reliance on the judgment of the whole people which is the foundation stone of practical democracy.

Embarrassing as may be the washing of linen in public, it is more wholesome than to let linen go unlaundered. Furthermore, the freedom of utterance embodied in the Bill of Rights and included even in its curtailed version can hardly be denied to citizens merely because they occupy places of high public responsibility; if anything, that right becomes a duty.

We are moved to this declaration, not alone because one at least of the men involved has long been a moving figure in the economics and sociology of agriculture wherewith our own technology is intertwined. We have had other and closer demonstrations as to the disastrous results of silence for the sake of superficial unity. Competition and criticism of ideas are vital not only to the preservation of liberty within a democracy, but to its effective defense from enemies without.

Production vs. Peasantry II

SINCE our comment under this title in the May issue of this year, a few members of the Society have challenged our opinion that the limited supplies of labor, machinery, and fertilizer will produce the most food if channeled to the most productive farmers. As one states his belief, "the much needed increase in farm production will have to come from the lower one-third. I believe this is a practical rather than a social standpoint. It seems to me that the larger farms, which as you point out produce 84 per cent, depend largely on hired labor and for this reason may actually have to cut down production." Another demurs at "agricultural industrialization."

First be it said that "bigness" in farms, in relation both to production and to labor requirement, is highly variable. We think of places in the Dakotas where 320 acres are the smallest farm which affords decent subsistence to an average family and needs no hired help. We have in mind a Wisconsin farm of 40 acres which in the busy season has twenty hired hands and produces crops worth several times as much as the Dakota farm. Each is efficient in its own conditions of soil, climate, and market.

As an important and rather representative food-growing area let us take the bread-and-butter state of Minnesota; as a comparatively normal time, the beginning of the year, 1935. Average farm acreage was close to the national average, and considerable dairying reduced the seasonal effect on farm employment, which obviously is at a low point in January.

As for any possible industrialization, we find that family labor outnumbered hired help more than eight to one. There was one farmhand for more than five farms, more than 800 acres. Only 31 farms among more than 200,000 had as many as ten employes. For the entire country, at that time, there was less than one-fourth of a hired man per farm.

If it were possible for the bottom third of farms to double their production, obviously a fantastic hope, it would add only three per cent to the nation's output of food and fiber. It would take less than four per cent increase by the top-third farmers to achieve the same addition to our food supplies. This would be a practical goal.

Now is no time to argue the moot question whether poor farmers make poor farms, or vice versa. That can be threshed out when there is no war to win. For the problems of the present, we should follow the principle laid down in the parable of the talents and give the means of production to farmers who have proved that they can produce.

New Developments in Sugar Beet Production

By Roy Bainer

MEMBER A.S.A.E.

DURING normal times the United States produces annually about one million acres of sugar beets. In the past this industry has been handicapped with an uneven labor demand in crop production. Labor peaks appear in the spring during the thinning and hoeing period and again in the fall when the crop is harvested. This peak labor, often referred to as "stoop labor", contributes greatly to production costs and to the attendant social problems in agriculture where high labor demands are prevalent for relatively short periods of time. Individual inventors and sugar companies, over a period of the past 40 years, have spent considerable time and money on attempts to mechanize the harvesting of beets. Little effort was directed toward the reduction of the spring labor peak. Studies made in California show that the spring labor peak is actually higher than the fall peak. For this reason it is essential to attack both phases of the labor problem, thus causing the work to be divided into two parts — one dealing with the processing of seed, planting, blocking, and thinning, and the other with harvesting investigations. This paper deals primarily with the processing of seed, but also with some of the problems and results arising from its use.

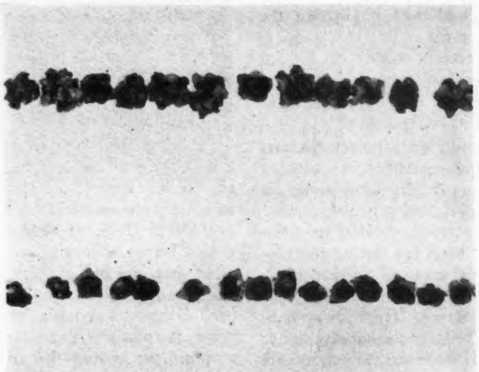


Fig. 1 Top, whole sugar beet seed. Bottom, sheared or segmented beet seed

An ideal stand of sugar beets contains from 100 to 120 uniformly spaced seedlings per 100 linear feet of row. A desirable aid in approaching such a stand by mechanical means lies in the development of a single-germ sugar beet seed ball. Coupled with this is the necessity of maintaining seed of high viability, treatment of the seed for protection against seed-borne organisms and soil infections, and the utilization of suitable planting equipment to provide uniform distribution of the seed in the row.

Sugar beet seed balls contain, on the average, more than one germ each. Thus if unprocessed seed balls are planted, they may produce from none to several seedlings per seed ball, making finger thinning imperative in order to obtain a uniform distribution of single seedlings. A reduction in the number of germs per seed ball will materially reduce the hand labor of thinning. Moreover, if the beets are to be thinned mechanically, or with a long-handled hoe, the percentage of potential singles are greatly increased. Any method that provides a higher percentage of single plants will be reflected in more favorable conditions for any mechanical harvesting system employing ground-topping methods. Beets grown in multiple combinations interfere seriously with successful ground-topping methods.

Attempts have been made in the past to produce a single-germ seed ball through plant breeding. The results to date have not been satisfactory. Dr. W. Knolle of the Institute of Land Machines at Halle, Germany, developed a process prior to 1940 for cracking sugar beet seed in an endeavor to reduce the number of germs per seed ball. This process was at once commercialized and a limited amount of seed was made available that year. Correspondence with the director of the experiment station at Halle yielded no technical information about the process. Therefore, a similar investigation was started at the University of California in an effort to produce a single-germ unit by mechanical means.

A laboratory machine was built in 1941 for breaking seed balls into segments, each containing approximately one germ. This machine consisted of a 4-in endless abrasive belt operating at 1350 fpm over two horizontal pulleys. The seed was fed onto the belt which in turn carried it under an adjustable shear bar located near one of the pulleys. The clearance between the shear bar and belt was maintained at approximately 0.08 in. Belts with various sizes of grit were used for cracking trials with this machine. The best performance resulted from belts having a grit size of 24 and 30.

During the segmenting process, the seed is engaged by the rough belt and carried under the shear bar. The pressure applied to the seed in passing under the shear bar caused breakage of the seed along natural cleavage planes between the seed cells. This produces a small flake of corky material enclosing the seed cell and germ. The product resulting from the process is known as segmented or sheared seed, (Fig. 1). In addition to the reduction in size of the segment as compared to the whole seed, some damage occurs. In some instances, the seed is exposed because of the removal of the corky sepals and portions of the pericarp. Occasionally a part of the seed coat is removed and in some cases the seed is broken exposing the endosperm. In general, however, the segmented seed has the appearance of whole seed except for particle size. Due to the change in size, the surface area is approximately twice as great as an equal weight of the original seed.

While the preliminary shearing machine gave satisfactory results, the capacity was only 100 lb of whole seed per hour, and the life of a belt about 20 min. Irrespective of these limitations, several hundred pounds of seed were sheared for experimental plantings in 1941.

Later a second machine (Fig. 2) was built to overcome the defects of the preliminary unit. The second unit made use

Fig. 2 Machine developed by agricultural engineers at the California Agricultural Experiment Station for shearing sugar beet seed

Paper presented at the annual meeting of the American Society of Agricultural Engineers at Purdue University, June, 1943. A contribution of the Power and Machinery Division.

ROY BAINER is associate professor of agricultural engineering and agricultural engineer in the California Agricultural Experiment Station.

AUTHOR'S NOTE: The experiments reported in this paper were carried on under a cooperative agreement between the Bureau of Plant Industry, Soils, and Agricultural Engineering, of the U. S. Department of Agriculture and the California Agricultural Experiment Station. The illustrations are from photographs taken by S. W. McBirney, A. A. Armer, and E. W. Weston. Dr. F. A. Brooks, Coby Lorenzen, Fred Lory, and H. D. Lewis assisted with the planter trials and developments. The project has been partially supported by grants from the U. S. Beet Sugar Association.

of a No. 20 grit, silicon-carbide, vitrified stone, 2 in wide and 10 in in diameter, (Norton Crystolon No. 3720 Q), mounted on a horizontal shaft supported by two sealed bearings (Fig. 3). A 1-hp electric motor furnished power to the shaft through a V-belt drive. An adjustable shear bar (made of chrome molybdenum No. 4145 steel and heat-treated) ½x1-5/16x2 in was used. A hopper conducted the seed more or less tangentially to the wheel. The principle of operation was similar to the original machine in that the rough stone carried the seed past the shear bar.

This machine, which has a net operating width of 1⅞ in, has a capacity of 400 lb of whole seed per hour when operating at a peripheral speed of 2000 fpm. Variations in speed from 1500 to 3000 fpm yielded approximately the same capacity.

During the preliminary trials of the equipment, the actual clearance between the stone and shear bar was measured in order to determine its relationship to performance. At the same time, an 8-in hand screen, having 8/64-in round holes, and a pan were used for making a quick separation test of the material coming from the machine. This test provides a satisfactory basis for setting the machine for different varieties of seed. Satisfactory performance results when 52 to 56 per cent of the material coming from the shearing machine is retained on the No. 8 screen. This corresponds to a setting of 0.085 to 0.088-in clearance between the bar and stone.

Following the shearing operation, it is necessary to grade and clean the material coming from the machine. A fanning mill with an aspirator type of feed was used for the final grading and cleaning. Definite recommendations as to screen sizes have been difficult to determine because of the limited experience with the seed. Results of recent tests with the seed grown under greenhouse conditions indicate that seedlings produced from segmented seed smaller than 7/64 in in diameter have a significantly lower unit weight at the end of the germination period than seedlings produced from larger seed units. The germination of this size was also quite low in comparison with the larger seed. Similar tests indicate that seed segments larger than 10/64 in in diameter produce too many multiple seedlings per seed unit. Therefore, the practice has been to use a 10/64-in round-hole sieve on top and a 7/64-in round-hole screen on the bottom of the cleaner. The seed that is scalped off over the No. 10 sieve is returned for further shearing while the seed that is screened out by the No. 7 screen is discarded.

During the shearing and cleaning operation, the seed is reduced to about one-half the original weight. However, the sheared sample has approximately twice as many seed segments per pound as there were seed balls in a pound of the whole seed. For example, one lot of U. S. 33 seed contained 5,920 seed balls per hundred grams before shearing and 10,650 seed segments per 100 grams after shearing and grading. Therefore, the actual recovery on the basis of original seed units amounts to 80 to 100 per cent by number. Germination trials indicate that, on the basis of a 45 to 50 per cent recovery by weight, sheared seed will give a germination within 5 per cent of that obtained from the whole seed. However, the sheared seed produces only 50 to 60 per cent as many seedlings as are produced from the same number of the original seed balls.

Sheared seed may be graded up to meet higher germination re-



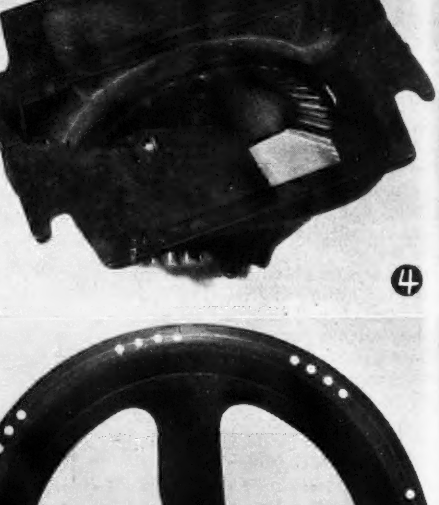



Fig. 3 Close-up view of silicon-carbide wheel and adjustable shear bar of beet seed shearing machine • Fig. 4 Modified seed metering unit for an internal-run type of beet drill. The feed wheel has 40 flutes on a 45-deg bevel. The metering plate is shown midway alongside of the wheel • Fig. 5 Modified external fluted-feed mechanism as built by the Minneapolis-Moline Power Implement Co. The tapered shield over the fluted section crowds surplus seeds away from the discharge side of the feed roll • Fig. 6 Plate developed for planting sheared seed in distributed hills. The plate is ⅛ in thick and has 5/32-in holes tapered from the bottom. The groove (1/32-in radius, 0.02 in deep) machined on the top side through the center line of the holes guided the star knocker wheel into the cells

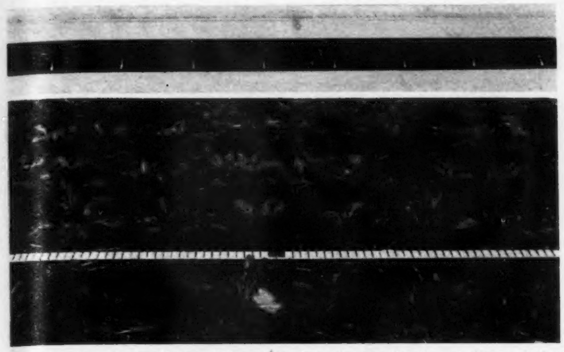


Fig. 7 (Top) Greased-board test showing the regularity of drop of the distributed hill planter • Fig. 8 (Bottom) A field planting made under adverse conditions with the distributed hill planter. The seeding rate was 2 lb per acre. This planting was not thinned

quirements by the use of a gravity-table separator. When sheared seed of 70 to 80 per cent germination is run over the gravity table, the heavier seed scalped off the high side of the machine will usually germinate above 90 per cent. This method offers possibilities in producing high quality of seed for use in conjunction with extremely low planting rates.

In the past the practice has been to plant whole seed at rates varying from 12 to 18 lb per acre. This yields many more plants than are necessary to give a satisfactory final stand. From 20 to 30 man-hours are required to thin these heavy stands. Experience resulting from the use of sheared seed on several thousand acres throughout the United States during 1942 indicates that seeding rates of 4 to 7 lb per acre produce sufficient seedlings to give satisfactory final stands. Such low seeding rates require greater accuracy in planting than was required with whole seed.

Before the introduction of sheared seed, Mervine and McBirney[1] carried on planting trials with reduced seeding rates of whole seed. Of the commercial planters used they found that the plate planter with special single-seed ball plates gave the most uniform distribution of seed. When sheared seed was introduced, special sheared-seed plates were developed and made commercially available. These plates were made with 72 to 80 cells, of a size that would accommodate the seed. They were adapted to regular plate planters, many of which were already in use.

Late in 1942, studies of various types of planting devices were started in anticipation of an increased use of sheared seed and a general shortage of plate type planters, due to government wartime regulations restricting the manufacture of agricultural equipment. These studies included performance tests of the planters and possible modifications for improving their seed distribution characteristics.

The Planet Jr. planter (made by S. L. Allen Co.) gave fair performance at seeding rate of 4 to 5 lb per acre. Modifications were made without any material improvement in performance, including the substitution of slotted holes (located both radially and tangentially) instead of the usual round holes, the speeding up the agitator wheel in an attempt to sweep the plate oftener to reduce length of skips, and the substitution of twin agitator wheels with blades that did not cross the hole but continually shifted the seed back and forth to provide flow uniformity and to prevent bridging.

A satisfactory modified seed-metering unit was developed for the internal-run type of feed mechanism such as used on the Oliver Superior beet drill. The modification consisted of substituting a wheel having 40 flutes on a 45-deg bevel instead of the regular wheel which had 16 flutes on a 17-deg bevel. The reason for using more flutes was an attempt to smooth out the flow of seed from the bottom of the seed cup. The flute bevel was made steep enough to shed seed steadily without a diverter, as the wheel left the lowest part of the cup (Fig. 4). A center-line scoop cut-off, or metering plate, was incorporated in the seed shell to eliminate all possibility of bridging of seed in the wedge-shaped seed cup. The opening between the meter plate and the feed wheel is such that the seed cannot feed into the wheel faster than the wheel can carry it through the final throat opening.

[1]E. M. Mervine and S. W. McBirney, Mechanization of Sugar-Beet Production. AGRICULTURAL ENGINEERING, vol. 20, no. 10, pp. 389-392, October 1939.

The external fluted-feed mechanism such as used on the Minneapolis-Moline Monitor drill was modified by substituting a 20-flute roll in place of the regular 10-flute roll and incorporating a more positive top delivery. This change modified the unit as to type of feed. The seed was actually carried out of the hopper between flutes on the roll instead of being dragged out by the under side of the roll. This modified unit was submitted to the Minneapolis-Moline Power Implement Company for manufacture. They made further improvements by reversing the direction of rotation of the roll and doubling its speed. This change of reversing the roll simplified changes in the seed shell which were necessary to accommodate this new feed (Fig. 5).

An experimental distributed hill plate was developed for use on a low-drop planter. The distance from the plate to the ground level on this planter was 7 in. The plate was constructed to plant four seeds 1.1 in apart in hills, the center to center distance of which was 9.9 in (Fig. 6). Other spacings can be obtained by changing the speed of the plate. A distinct distributed hill was obtained in the greased board tests, (Fig. 7) and in the field (Fig. 8). When a similar plate was tried on a planter with a 34-in drop, the hill effect was lost indicating crossed trajectories resulting from different paths followed by seed in dropping through the longer seed tube. The reason for developing distributed hill planting was to attempt to eliminate thinning entirely. In general, field germination under average conditions amounts to less than 50 per cent. By planting four seeds per hill, the likelihood of obtaining one or two plants in each hill appears to be possible. If extra plants are produced in a hill, they can be treated as weeds during the normal hoeing operation, thereby eliminating a separate thinning operation.

Only one experimental test has been made with the distributed hill planter. A seeding rate of 2 lb per acre was used which gave an average of 4.5 seeds per hill, the center to center distance of which was approximately 10 in. The planting was made quite late under adverse field and weather conditions. The segmented seed planted had been scalped off from the heavy side of a gravity separator and regraded between 9/64 and 7/64-in round-hole screens. This treatment brought the laboratory germination test of this sample up to 91.5 per cent. This planting has not been thinned; a beet was cut out of an occasional hill when the beets were hoed for weed control. The final stand in this field amounted to 87 beets per 100 ft (Table 1). The factor of safety of planting four seeds in a hill when only one plant is wanted came close to producing a satisfactory stand under the rather adverse conditions of this experiment. Further work is contemplated with this type of planting in an endeavor to eliminate thinning as a separate operation.

TABLE 1. A TABULATION OF LABORATORY GERMINATION, SEEDING RATES, WEIGHT PER BUSHEL, AND STAND COUNTS FOR 4 GRADES OF SEED USED IN PLANTINGS MADE UNDER ADVERSE WEATHER CONDITIONS

Seed Used	Laboratory germination, per cent	Wt. per bushel, lb.	Rate, lb per acre	Seedlings per 100 in	Beet inch per 100 in	Per cent of inches with singles	Thinned stand beets per 100 in
Sheared	83	29.5	6.5	22.3	16.3	75	114
Sheared, medium gravity	55.5	27.0	6.6	14.7	10.6	78	94
Sheared, heavy gravity	92.0	33.0	3.0	16.1	14.3	82	105
Sheared, heavy gravity (Graded 9 to 7 and planted with distributed hill planter)	91.5	34.5	2.0	11.5	9.1	82	87

Three other plantings were made in the same field in addition to the distributed hill planting at the same time with other grades of the same seed planted with a regular 72-cell sheared-seed plate. The adverse field conditions for planting are reflected by the poor prethinned seedling stand of these plantings, yet when thinning was done with a long-handled hoe satisfactory final stands were obtained (Table 1).

Mechanical thinning of plantings made with sheared seed offers attractive labor-saving potentialities. The ordinary beet cultivator, operated across the field at right angles to the row when equipped with properly spaced knives of correct length, is all that is necessary for mechanically blocking or thinning of beets grown on even ground (Fig. 9). Twenty to thirty feet of cultivation equipment can be pulled by a small row-crop tractor. The cultivator should be equipped with markers, similar to the ones used on planters, for indicating subsequent paths through the field. Weeder knives

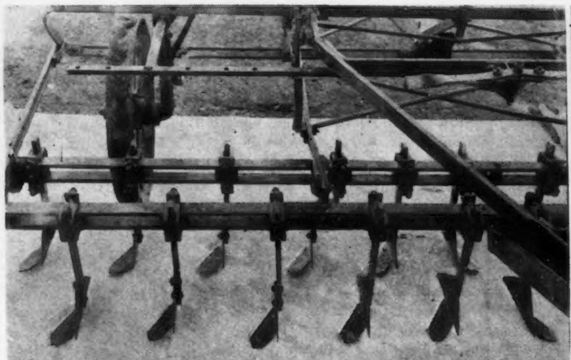


Fig. 9 (Left) A beet cultivator equipped with knives for cross blocking. This set-up makes 3-in cuts and leaves 2-in blocks • Fig. 10 (Right) Six sets of "Dixie" beet thinner rotors mounted on the tool bar of a row-crop tractor

of the half sweep type, mounted alternately on the front and rear cultivator tool bar to reduce the tendency to collect trash, work satisfactorily for cross blocking. A combination of knives that leave 2-in uncut blocks on 6-in centers provides about 90 beet containing blocks per 100 ft of row when operating in a germination stand of 30 per cent (30 beet containing inches per 100 in of row). Some long-handled hoe work is required to reduce the blocks to single seedlings. Mervine and Barmington[2] carried on some excellent mechanical thinning trials in conjunction with sheared-seed plantings in 1942. Their studies indicate that it is practical to thin beets mechanically without causing reduced yields. At the same time, they were able to show a saving of 90 per cent in the labor required for mechanical thinning when compared to the customary hand blocking and thinning. The results of time studies made on four different methods of thinning a field, when planted with sheared seed at the rate of 7 lb per acre, is shown in Table 2.

TABLE 2. TIME STUDIES OF FOUR METHODS USED IN THINNING A 30-ACRE FIELD PLANTED TO SHEARED SEED NEAR FT. COLLINS, COLORADO

Method	Man hours per acre	Yield in tons per acre
Complete mechanical thinning	2.45	12.24
Mechanical blocking plus long-handled hoe	11.6	11.40
Long-handled hoe thinning	15.6	11.47
Customary hand blocking and thinning	27.2	12.17

The mechanical thinning was done with special thinning knives attached to a regular cultivator. The knives made a 3-in cut and were set to leave a 1-in block. Only 0.45 man-hour per acre was required for operating the machine. When the first hoeing was done 2 man-hours additional were required per acre to cut out surplus beets. The mechanical blocking was done with a cultivator set to leave a 2-in block on 6-in centers.

When beets are grown on beds, cross cultivation is impossible. Therefore, some type of down-the-row blocker is required. Trials at Davis were made with the "Dixie" beet thinner (Fig. 10). This machine, made commercially available this season, incorporates two rotary heads with sufficient provision for adjustment for use on either bed or flat planted beets. The machine operates down two adjacent rows of beets, cutting across the row, leaving predetermined blocks on uniformly fixed centers. The knives may be adjusted to give any desired size of block. The center to center distance of blocks is determined by the final drive ratio. Results of trials with the "Dixie" machine when operating in a 35 per cent stand of beets are shown in Table 3.

TABLE 3. RESULTS OF TESTS WITH THE DIXIE BEET THINNER WHEN OPERATED TO LEAVE THREE DIFFERENT SIZES OF BLOCKS ON 5-IN CENTERS

Block spacing	Width of block	Beet containing block per 100 ft	Total plants on blocks per 100 ft	Singles per 100 ft	Per cent singles
5 in	2 in	146	249	77	52
5 in	1¾ in	130	218	71	55
5 in	1½ in	105	160	64	61

[2]E. M. Mervine and R. D. Barmington, Mechanical Thinning of Sugar Beets. Colorado Agricultural Experiment Station Bulletin No. 476, March 1943.

During 1941, one acre of beets was produced from sheared seed. The following year approximately 10,000 acres were so planted throughout the United States. Observations made during 1942 indicate that it is possible to save at least 10 man-hours per acre when hand-thinning methods are used. Thus on approximately 300,000 acres planted to sheared seed in 1943 there was an estimated saving in labor amounting to 3 million man-hours. The total acreage in beets this year amounts to only about 60 per cent of normal production. When the use of sheared seed is extended to the normal production of 1 million acres and the thinning is eliminated by improved planting technique, or is done mechanically, the potential saving in labor will amount to over 20 million man-hours per year.

In summing up the situation regarding the adoption of sheared seed in sugar beet production, it is possible to save from 30 to 40 per cent of the thinning labor through the use of long-handled hoe thinning, with a potential saving of 90 per cent or more where the thinning is done mechanically or improved planting technique is followed.

The 1944 Farm Machinery Program

By L. L. Needler

WE ARE now on the threshold of the 1944 farm machinery production year. The experience gained in distribution and rationing in 1943 should lead to a better and less complicated program for 1944. Order L-257, recently announced, provides for considerably greater production. The concentration plan provided in this order is much less significant than in Order L-170. By comparison with Order L-170, four months' time has been gained. The nation has become food conscious, making it a little easier to keep materials flowing to the factories. These and other factors will make the 1944 program much less difficult. Probably fewer machines will be rationed and definitely fewer machines will be subject to distribution control under the new distribution order that is now taking form, and which we trust can be announced within a short time.

In 1944 the national welfare will depend perhaps more than ever before on the food production of the American farmer. The importance of food will reach a new high in our history. Acreage campaigns will be intense. Radical shifts in production may be necessary. In my judgment these campaigns cannot be most successfully achieved by the War Food Administration without at the same time giving farmers some definite assurance that their machinery requirements will be met in so far as that is possible. Therefore, perhaps certain vital machines such as corn pickers, combines, potato diggers, tractors, etc., may be handled under a state quota system.

It has been found that a reserve of a reasonably small percentage of the total production, when (Continued on page 280)

An abridged statement before the annual meeting of the American Society of Agricultural Engineers at Lafayette, Ind., June, 1943.

L. L. NEEDLER is chief, distribution of farm supplies, War Food Administration.

A Rational Approach to Farm Building Problems

By J. L. Strahan

MEMBER A.S.A.E.

THERE can be little doubt about the imminence and magnitude of the job that lies ahead in the farm building field. At the last fall meeting of the American Society of Agricultural Engineers in Chicago one of our members attempted to state it in dollars, and arrived at 20 billions. I have never, until recently, seen so much attention given by the farm press and by building trade papers, both editorially and through advertising, to matters pertaining to farm structures. I have just completed an engagement with an organization operating a loaning program in the eleven northeastern states which, over a five-year period ending June 30, 1942, handled approximately 1,000 farms, average farms, which required certain repair and development work to be done to bring them up to very modest minimum standards and to adapt them to carefully thought-out specific enterprises. The average construction loan was just under $1,200. If every farm in these same eleven states were to be treated in this manner, the total cost would run to 630 million dollars. From the standpoint of physical condition of buildings, the northeast is by no means relatively poor, but we still get an astronomical figure.

We are moving toward this job. Time is running short before it will be on us. How are we going to tackle it? The first thing that strikes me is that the job is not going to be done solely by agricultural engineers, though they will have a very intimate and significant influence upon it. Others will be deeply involved. Agricultural economists or farm management specialists, manufacturers of building materials, rural builders, carpenters, contractors and dealers, and the farmers themselves, as well as agricultural engineers, are the people who collectively will have the job to do. Each will have a definite contribution to make and each will make it according to what he thinks is his proper point of view, or in his best interests. The farm management specialist will influence the investment ceiling, the engineer will contribute designs, the manufacturer will make materials available, the builders will do the construction work, and the farmer will say what he wants, and when and if he gets it will live with it and pay for it.

In order to come close to an analysis of the problem, can we not agree that the entire postwar building program will consist of nothing more nor less than the sum total of all of the individual farmer's building projects? If so, then what is true of the typical individual project will form a reasonable basis for generalizations concerning the over-all program.

Consider first how any farm building comes into being. The completed structure represents the end results of a number of interrelated functions which for the sake of analysis can be separated out, with the understanding that, in the case of simple projects, many of them if not all will be performed by the same individual, and that different individuals will be brought into the picture only as the project becomes more complicated.

What are these functions?

1 Someone must say whether the building shall be built. No doubt in all cases this will be the owner of the property.

2 Someone must say how much can be paid for it. This will be the owner of the property also, frequently acting with the advice of specialists such as agricultural economists and farm management specialists. It is essentially a management function.

3 Someone must say how it shall be built—in detail—must design it. This is the engineer's function and operates either directly or through builders, extension specialists, manufacturers of materials, and other services which provide working plans and specifications.

4 Someone must provide materials. Occasionally native materials are available and can be processed from their original form by the farmer on his own property. It is probably true, however, when considering all of the specialties involved such as hardware, roofing, cement, etc., that 95 per cent of all materials now in common use and which will be in common use hereafter will be manufactured by industry and distributed through local dealers.

5 Someone must assemble the materials required for the job, provide for labor of different kinds, and in the proper sequence and supervise the erection to completion. This is the contracting function and may be performed by a contractor, a dealer, or the farmer himself.

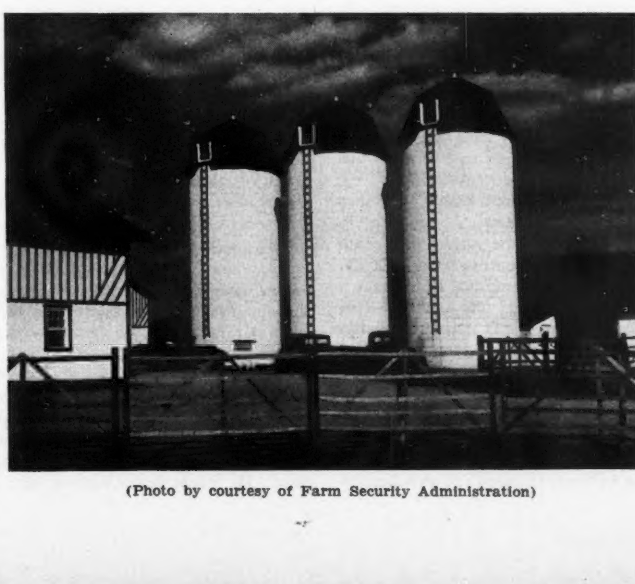
6 Someone must actually fabricate the materials under supervision. This is the mechanical function of labor. To get the best results it calls for skills that can be perfected only through experience, something that all farmers contrary to the generally accepted idea *do not have*.

I would like to consider each of these functions separately as though they were performed by different individuals, because the point of view of the individual in approaching his job is the important, significant factor in determining the degree of effectiveness of that individual's contribution.

It seems to me that any man who performs one or more of the functions mentioned above will approach his job primarily from one of two standpoints. If the function lies in the field of management he will be either *reasonable* or *unreasonable*. If his function lies in the technical field his approach will be either rational or empirical. What I would like most emphatically to urge here is that no matter with what field he is concerned, he will be more effective and his work will click better with others concerned if he is reasonable or rational than if he is unreasonable or empirical. Is it then unreasonable for me to suggest the possibility of developing a point of view or pattern of thought with respect to farm structures that will have reason and rationale as its basic principle and that will automatically reject unreason, wishful thinking, empiricism?

Let me explain what I mean. Consider the farm management specialist. He will frequently be called upon to advise farmers as to building investment ceilings. How much can the farmer afford to pay?

This specialist is concerned with the problem of financing the building. To him very properly the most important factor is that of cost. He is insistent that one way or another the cost must be kept down. There can be no valid quarrel with this point of view provided his ways of keeping the cost down are themselves reasonable. But to get costs down below a ceiling that is set as the result of wishful thinking is as unreasonable as it would be for an



(Photo by courtesy of Farm Security Administration)

Paper presented at the annual meeting of the American Society of Agricultural Engineers at Lafayette, Indiana, June, 1943. A contribution of the Farm Structures Division.

J. L. STRAHAN is agricultural engineer, Flintkote Co.

engineer to design a load-bearing member without considering the structural characteristics of the material to be used. On the other hand, to keep the investment below a ceiling that is set reasonably is an obligation on the designer that he cannot avoid without laying himself open to justifiable criticism. What then is an unreasonable investment ceiling and what is a reasonable one?

I once asked a group of farm management specialists, all members of the same organization, all performing essentially the same function with respect to a farm loaning program, how much investment per hen a farmer would be justified in paying for a laying house. After a little hedging to establish a more exact basis for a reply, my answers ranged from 50c to $4.00. Obviously here is no basis for controlling an engineer's design. No farmer would know where to start with such a wide choice of ceilings. If he accepts the low limit we could almost guarantee that he will not get a house that will function as the poultry specialist insists that it must . . . and if he accepts the high one he will most certainly spend more than he should. This is an example of empirical or unreasonable thinking, which more frequently than it should influences design and construction. Personal opinion largely unsupported by statistical or other evidence is not a satisfactory basis for setting an investment ceiling.

Is it, however, unreasonable to expect a poultry management expert to indicate, as one of the justifiable elements of the cost of producing eggs, an amount which each hen should pay annually in rent for the use of a laying house? It ought not to be impossible to break down the total cost into such items as feed cost, labor cost, flock depreciation, rent per hen, etc. If the rent item is 20c, then assuming a 10 per cent annual return from the building investment to be necessary, it is proper to invest $2.00 per bird in the house. If the designer by a clever use of materials and labor can provide the basic use requirements for less than the $2.00 per bird, say $1.80, then the hen will be required to pay only 18c rent and the difference of 2c will result in that much more profit from the enterprise. On the other hand, if basic use requirements can be met only at more than $2.00 per bird, then it is up to the designer to show that the extra investment represents improvements in the building that will help to hold feed or labor or other cost items down.

THE RATIONAL APPROACH TO THE PROBLEM OF DETERMINING HOW TO SET CONSTRUCTION INVESTMENT CEILINGS

Applying the same thinking to dairy cows, a cost of $100.00 per cow for a stable will require a $10.00 annual rent for each animal housed. A barn housing cows and hay, a two-story structure, will probably cost more than $100.00, but the additional cost of storing hay should not be charged directly to the cow. It represents one of the elements of the cost of producing the hay. It will be argued that the cow must pay for the hay anyway, which is true. But if the hay is too expensive because of the cost of storing it, then this should reflect an excessive feed cost and not an excessive stabling cost. The cow should not be deprived of a proper stable because it costs more than market value to produce and store its feed. Rather, the farmer should be advised to look into his methods of producing feed and to attempt to increase his efficiency in that enterprise. Likewise 10 per cent of the cost of a silo per ton of capacity should be charged against the cost of the silage. A silo that has a capacity of 80 tons might cost $500.00. This represents a capital outlay of $6.25 per ton. Therefore, each ton of silage should be charged 62½c in addition to other cost items when figuring how much the cows will be required to pay for it as feed. If this 62½c is going to make feeding silage unprofitable, all things considered, then perhaps the enterprise had better not attempt to support a silo. To my mind this represents the rational approach to the management problem of determining how to set construction investment ceilings. If management will be rational in setting a maximum cost per livestock unit or per storage unit under specific conditions, then the engineer in most cases will deliver a design that will be both technically and economically acceptable for those conditions. In those rare cases where he cannot, then perhaps both the farmer and the management expert will be willing to raise the ceiling, if he wants and needs the service.

Consider now the point of view of the manufacturer or large distributor of building materials. Is it rational or irrational, reasonable or unreasonable? To stay in business he must sell an adequate volume at a reasonable profit. In a competitive market his sales organization must exercise all of its ingenuity to reach this objective. Shall he, therefore, sell *any* amount of materials to *anyone* he can induce to buy it regardless of its adaptability for the purpose in view simply because the sale is possible and solely for the purpose of increasing his volume? Any reputable manufacturer of experience would recognize this as a quick road to the destruction of good will and ultimate bankruptcy. His volume is not going to depend upon any number of first sales to new customers. On the contrary, it will depend upon the reputation his materials make in service. And his materials will make a good reputation only if they are properly used and properly applied. The sensible thing for him to do, therefore, is to study the specific needs of his prospective customers, to work out practical solutions of specific building problems where the physical characteristics of his products lend themselves, and to keep away from applications where they do not.

It doesn't take an unusually acute observer to note that industries have been proceeding along these reasonable lines for some time past. To mention just a few, the cement industry has done an outstanding job in educating the farmer in the proper mixing and use of concrete. The insulation industry, the clay products industry, the steel industry, lumber, plywood, and asphalt products are all following this policy.

WILL THE SMALL DEALER AND CONTRACTOR BUILD THE BULK OF THE FARM BUILDINGS AFTER THE WAR?

What now about the small dealer and contractor? What is his function and what is his point of view? He is the one, I believe, who is going to build the bulk of the farm buildings after the war. He will handle the materials and furnish the labor to get the work done. But he has not yet fully appreciated his opportunity, largely perhaps because of a prevalent idea that the farmer will continue to do his own construction work.

For a number of reasons I think the farmer is going to do less and less of his own construction work and will be forced to look more and more to an outside source for this service.

Mention was made earlier in this paper of a loaning program which extended over a period of five years and involved about 1,000 farms in the northeast. At the end of the five-year period an analysis was made of the method of doing the construction. Each borrower had wide latitude in the administration of his own construction loan funds. He was asked to state when he obtained his loan, how he proposed to get the work done, whether by contract, by hired labor, or by his own labor. Very few, less than 3 per cent, chose the contract method. They all wished to function as contractor, and many as both contractor and laborer. In this they were encouraged by the management specialists who thought they saw a real opportunity to save money. But what were the results?

The analysis showed that at the end of five years almost 10 per cent of all borrowers who received their loans during the first year of the program still had loan money in the bank and construction work not yet completed. Of the second-year borrowers about 30 per cent had not completed their construction. Of the third-year borrowers about 70 per cent were incomplete. Of the fourth and fifth-year borrowers only an insignificant number had completed their projects. The over-all average time to complete was between four and five years. Now the loans were made on the assumption that the facilities were needed to get the individual farm enterprises on a going basis, yet the work dragged on under the mistaken idea that money was being saved. These people did need the facilities; they were conscientious in believing that they could do the work themselves, but the simple fact is that they *did not perform.*

As another concrete example, a young and ambitious farmer of my acquaintance recently needed a brooder house to start his new flock this spring. He made several tries to save himself money and time by attempting to convert an old granary. After fussing with it for several weeks, he finally wrecked it and used the lumber for the new brooder which he completed after purchasing $60.00 worth of additional materials. In the meantime, he lost 100 good sexed chicks to rats who robbed his old brooder house in spite of his best efforts to keep them out, and was late in getting the first spray on 50 acres of McIntosh apple trees. And he wore himself out half doing a job that he wasn't particularly fitted for in the first place. He might better have bought a good brooder house, saved

all his chicks, and been up to schedule with his most important income-producing enterprise.

These and other similar observations have led me to the opinion that the day of the jack-of-all-trades on the farm is past; that just as the farmer's wife has long since quit spinning and weaving to make her husband's clothes, so the farmer must stop trying to build adequate shelter for his family, his stock, and his crops. He lacks time, equipment, and mechanical skill for handling the newer building materials. When he needs a facility to implement one of his agricultural enterprises, he needs it immediately, not six months or a year or five years hence.

If he is not going to do his own construction work, where will he look for service? Obviously to the local building material dealer, rural carpenter, and contractor.

Now the question must be faced as to whether these dealers and contractors are prepared to take on the job. My experience has been that they are only partially and somewhat meagerly so. They are not as yet sufficiently agricultural-engineering minded. Being more profit-minded than technically minded, they are still very likely to build down to a price at the expense of good design, adequate functioning, and slow depreciation. If they would take full advantage of the coming opportunity they must to a much greater extent adapt the recommendations of engineers and other agricultural extension specialists to their practice. Then those recommendations will begin to have their full effect. One reason, and I believe a very potent one, why improvements have been so slow in coming is that this important link in the chain between design ideas and their materialization, the rural dealer and builder, has been unrecognized and therefore sidestepped by the institutions. Extension service philosophy has largely assumed that farmers will do their own construction work, whereas they cannot, and still continue to produce efficiently as farmers.

(Photo by courtesy of Farm Security Administration)

Perhaps the extension services are missing a good bet by not making a more direct approach to rural dealers and builders to make them more agricultural-engineering minded. If the institutions in addition to directing latest findings on design and construction to farmers will also educate rural builders to design, estimate, and execute the work in accordance with newest accepted practices, the farm building program, I believe, will be very greatly accelerated, and along approved lines. Furthermore, rural builders will become more and more professional in their operations and therefore more in demand by farmers who realize the value of their own time. A very vivid example of the soundness of this principle lies in the current drive on the part of some dealers to manufacture small prefabricated moveable farm buildings such as brooders, farrowing houses, range shelters, etc. Such units are now being sold for somewhat more than farmers have been willing in the past to invest in them, for three reasons. First, they are better than farmers can build for themselves; second, the farmer's time is worth more to the income-producing farm enterprise than the difference between homemade and purchased buildings, and, third, the burden of undertaking the contractor's function is lifted from the shoulders of the farm owner to those of one who is much better qualified to perform by virtue of experience and the possession of necessary equipment.

There is no difference in principle between small and large buildings. I believe farmers will buy valuable and adequate service once it is available, and once they appreciate the savings they can make by using their time more effectively in productive enterprises. I believe that a realistic appraisal of the value of an efficient contracting service will show that it will pay its own way.

What then is the sensible, reasonable thing for the country dealer and contractor to do right now? In lieu of any organized extension teaching program, and until such may become available to him is it not reasonable for him to study farm building needs, to become a specialist in constructing housing for poultry, hogs, dairy cattle, crops, and farm humans and then to convince the farmer that he had better leave his construction problems in competent, experienced hands? My guess is that a builder who establishes a reputation for knowing the practical, up-to-date answers to the many construction questions facing farmers today, and for doing good work in executing well-engineered designs will have no trouble getting all the business he can handle. And that goes too for the dealer who in the past has done contracting on the side to provide an outlet for his goods. More than likely he will develop into a contractor who will run a materials business on the side as a means of keeping up with his contract demands. The emphasis is very likely to shift.

Now we come to the agricultural engineers. How can we expect the building industry to accept technical advice, ostensibly from the agricultural-engineering profession, when this advice appears not to be founded on good common sense? Our classic example of confusion completely confounded is the question of poultry housing.

When it is considered that most of the advice on poultry housing comes from poultry specialists, men who are much better scientists or naturalists than they are engineers or physicists, it is obvious that the blame for wide variations in recommendations cannot be laid wholly on the engineers. Nevertheless, a 500 per cent variation in that feature of laying house design which analysis shows to be of basic functional importance is a reflection on the agricultural-engineering profession as long as no effort is made to reconcile the differences through the application of a rationalized technique. It is in the same category with the 50c to $4.00 range of opinion concerning permissible investment per hen in a laying house, which in the same manner reflects against the farm management specialists. Both are the result of empirical observations and thinking. In the field of design the engineers certainly ought to do something about it.

What, for instance, can they do? I have several times suggested that the principle of heat balance be applied to control design of animal shelter buildings. For the sake of the record, this principle is best expressed in the form of an equation as follows:

$$H = \frac{VD}{53} + ACD$$

in which

H = heat produced per unit of livestock housed per hour

V = volume of air change per hour per unit of livestock housed

D = difference between outdoor and indoor temperature in degrees Fahrenheit

A = area of exposure to heat loss per unit of livestock housed in square feet

C = heat loss in Btu per sq ft per degree of temperature difference per hour (average)

53 = number of cubic feet of air raised 1 F by 1 Btu.

This equation is based on the assumption that all heat produced within the building is dissipated by a varying combination of air change and radiation, the values for D being stated in degrees F and the other factors be in terms of the animal unit.

Two of these factors, A and C, are functions of the design of the building. If the total area of exposure to heat loss is large in relation to the number of livestock units, then A or the unit area will be comparatively large. If the construction is loose and uninsulated then the value of C is comparatively large, and the product of the two, which expresses the Btu of heat lost per unit of livestock per degree of temperature difference per hour, is large. On the other hand, if the design is compact, exposing a minimum area to heat loss, and if the building is well insulated, then the product of A and C will be small, denoting a comparatively small unit loss of heat by radiation. Obviously, if the radiant heat loss is small, more heat is available to maintain a desirable temperature and to carry moisture away through a controlled ventilating system. There can be little objection to the theory, but the application of it has been subject to what appear to be justifiable criticisms for several reasons. One is that the factor H, which in application must be considered as a constant, is in reality a variable. It represents heat produced per animal unit per hour. It is known that the production of sensible heat varies with environmental temperature. Animals presumably produce more when it is cold than when hot. Two other factors also vary to some extent. The number of cubic feet of air that can be warmed 1 deg by 1 Btu varies through a small range depending upon the starting temperature, but from the standpoint of the use for which the equation is intended this variation is so small as to be negligible. There can be no doubt as to the variability of the weather, which is expressed in the formula by D, the temperature difference between indoors and outdoors. However, weather changes, after the building is designed for a specific assumed value for D, are expected to be and can be compensated for by controlling the rate of air change. Ventilation is expected to be restricted as the value of D increases and increased when D becomes smaller.

THE AUTHOR PROPOSES AN EQUATION TO SERVE AS A GUIDE FOR THE ENGINEER IN THE DESIGN OF A FARM BUILDING

It seems to me therefore that objections which may be theoretically valid become of minor significance when the purpose behind the use of the equation is considered. Its purpose is to furnish a guide to the design of a building which, once constructed, is constant or practically so in its characteristics. When the building is finished, the value of A remains constant. The shape of the building does not change. Also the value of C is constant. The materials of which the building is made do not change, though this C value may be modified somewhat by putting up storm sash and storm doors in winter. Therefore, inasmuch as the building must be constructed in *some* shape and of *some* materials, it would appear reasonable to assume *some* average values for the variables, to select *some* set of conditions which are most likely to prevail during that period of the year when temperature and moisture control is important and design for that set of conditions. On this assumption, which I have felt to be reasonable, I have used 3,000 Btu as the value for H in dairy stable design. For reasons stated in a paper, entitled "A Temperature Control Index in Dairy Stable Standardization", published in AGRICULTURAL ENGINEERING for October 1932, I have used 40 as the value of D in zone 1, 34 in zone 2, and 28 in zone 3. For the value of V, I have used 2600 in zone 1, 3175 in zone 2, and 3550 in zone 3. When these values are substituted in an algebraic transformation of the equation placing A and C on one side and the other factors on the other as

$$AC = \frac{H}{D} - \frac{V}{53}$$

I derived the following indices: For zone 1 — 26; for zone 2 — 30; for zone 3 — 38.

These indices state the number of Btu that will be lost by radiation per animal unit per degree temperature difference per hour from the building. They represent heat conservation characteristics of the design appropriate to the different climatic zones. They therefore provide a guide to the manipulation of the various factors of space arrangement, wall height, glass exposure, insulation, and ventilation design, etc., which will enable the engineer to produce a building that will function within the limits set by his problem. In zone 1 it will call for a compact, well-insulated design, the elements of which can be specified precisely according to the choice of materials at the engineer's disposal. In zone 3 insulation and space relations can be considerably relaxed with a resulting proper adaptation to the local climatic conditions.

I expect that only experience will demonstrate to each designer what the proper value for the index really is in any given location. For my part, having analyzed a number of designs and observed results in each, I am satisfied with the values stated.

An application of the same principle was made to poultry laying house design in a paper, entitled "A Rational Approach to Poultry House Design", published in AGRICULTURAL ENGINEERING for September 1940. Because the animal unit in relation to area of exposure is here very much smaller than in the dairy stable, the values for AC are correspondingly small. For zone 1 the index is somewhat less than 1.0, in zone 2 between 1.0 and 1.5, and in zone 3 it might conceivably be disregarded entirely on economic grounds.

These illustrations represent a rational as opposed to an empirical treatment of the design problem, which seems to me should be the engineer's primary contribution to the over-all farm building program. The use of such a well-founded technique will not only give the profession a confidence in its own contribution, but will render that contribution acceptable to the man who builds the building and to the man who has to pay for it and use it.

BETTER PRACTICE FOR DESIGNERS TO ACCEPT A GUIDE BASED ON A RATIONAL CONSIDERATION OF BEST INFORMATION

Is it not better practice for designers to accept a guide based upon a rational consideration of the best information available than to go upon impressions and guesses or worse yet upon common local practices? Is it not better to have a yardstick against which to measure the propriety of using many different combinations of materials than to attempt, as seems to be the trend, to standardize detail? The former method controls while providing great flexibility in the use and adaptation of materials, while the latter is a straightjacket which *definitely* limits the design function. The rational method leaves wide open the opportunity for designers to exercise ingenuity in adapting combinations of materials most easily available for the best economic solution of the immediate problem, thereby permitting free play to that competition which is inherent to the American scheme of things.

It seems then that various individuals, groups, and agencies are concerned in one way or another with farm building construction. Of course, the farmer is primarily concerned, but he must look to economists for advice as to reasonable investment limitations, to engineers for sound design, to builders for adequate execution of the designs, and to industry for standard materials and for the development of newer, more adaptable materials. It seems to me that there are two ways for each of these contributors to look at this job. One, empirical, cut and try, follow the old ideas; the other, rational, reasonable, the determination of new solutions for problems, which may not in themselves be new but which undoubtedly will be presented in new settings.

The fact that farmers are going to be very, very busy feeding not only our own people but also the people of half a world is going to make it imperative that they spend their time at the job of producing and leave to those better qualified the job of providing them with their facilities, their tools of production. Rest assured the farmer will demand this service. Therefore it is reasonable for all concerned to prepare now to meet the demand. Let the economists stop worrying about construction costs and concentrate on reasonable investment ceilings. Let the engineers rationalize their technique so as to provide a base for operations that is acceptable. Let the extension agencies extend the engineers' contributions to those who will put 90 per cent of the design ideas into concrete form, the rural dealer and contractor. Let the industries provide the materials and recommend proper adaptations through their normal outlets, the dealer and contractor, and finally let the farmer know by every avenue possible that a sound body of advice and service is available to him whereby he can be relieved of what up to now has caused him many headaches, so that he can concentrate on his real job of efficient production.

Small Dehydrators for Farm Home Use

By Geo. W. Kable

FELLOW A.S.A.E.

SMALL dehydrators have broken the record for quickly arousing the interest of investigators and manufacturers in a piece of home equipment. There are few agricultural colleges that have not issued bulletins on the subject and many have their own designs for homemade equipment. Electric power companies are equally active in putting out instructions and plans, and the interest goes right up to the vice-presidents. It has also been reported that some forty manufacturers have indicated to different branches of the government that they would like to build home dehydration equipment.

Some of our own members have argued the case of home dehydrators before WPB and Senate committees until materials have finally been set aside for building 100,000 electric home dehydrators this year.

The National Dehydrators Association composed of the leading commercial food processors are also interested in home dehydration, but for a different reason. These processors are said to have more than $100,000,000 invested in the industry to dehydrate some 1,750,000,000 pounds of foods for the Army, Navy, and Lend-lease this summer. When the war is over they expect to sell dehydrated products to the public and they want to see to it now that the public taste for dehydrated foods is not ruined by poor products coming out of kitchen dehydrators.

Dehydration is not solely a process of drying foods. The drying must be done in a manner to retain the color, nutrients, vitamins, and appetizing appeal of the original foods, and so they will rehydrate as nearly as possible to the quality of those foods in their fresh condition. From the standpoint of processing methods and equipment design, this is a very different matter from just drying the foods.

Commercial dehydrators have succeeded in producing excellent products in recent years. The change has been not so much in the design of the equipment used as in the technique of selection, preparation, preprocessing, and precooking, and in packaging and storage. Different foods require quite different preprocessing procedures and different drying temperatures.

For the sake of distinction, a drier is a piece of equipment which aids in the removal of water from a substance; a dehydrator is a drier in which the drying process — the temperature, air movement, and humidity — is under the control of the operator. All dehydrators are driers; not all driers are dehydrators.

Some of the well-designed small dehydrators have produced dried foods equal to commercial products in quality, but the same intelligent care in handling before and during drying is as necessary as with commercial size units.

Home dehydration is a food-saving process but not a labor-saving process. The preparation of the foods and preprocessing requires more time and labor and more equipment than similar preprocessing for either canning or freezing. Whether housewives are pleased with their home dehydrated products next winter will depend as much or more on how well they have learned and followed the correct procedures in dehydrating as on the drier they use to remove the moisture.

Quick drying is desirable to preserve quality, but at the same time the foods must not be overheated. This calls for some knowledge of the drying process.

In studies of prune dehydration at constant air temperatures made by the author in association with Prof. E. H. Wiegand of Oregon State College a number of years ago, we found that the time to speed up drying was in the first few hours after the prunes were put in the drier. Other investigators have come to similar conclusions. The accompanying curves are typical of what may be expected in drying foods at constant temperatures. The exact shape of the curves will vary with a number of different factors. What I wish to point out is that drying takes place most rapidly at the beginning when the air temperature is high, and that the rate of drying does not vary so greatly with different temperatures near the end of the drying period. This was true also to a limited degree with relative humidities. It was possible, however, to do reasonably fast drying with relative humidities as high as 40 per cent when the higher temperatures were used.

With the limited wattage used in most home dehydrators and without a thermal control, we get conditions which are just the opposite of those which are optimum. Because of the evaporation of free moisture the temperature comes up very slowly at first and the relative humidity is high. In fact, to get the temperature up some operators recommend closing the vents and permitting the moisture in the air to build up toward the saturation point. Near the end of the drying time the temperature tends to be high and the humidity low.

In order to reverse the natural temperature and humidity conditions as much as possible some method of temperature control either manual or automatic, is desirable. There is little danger of overheating foods during the first quarter of their drying period when moisture is being freely evaporated from them. The evaporation has a cooling effect so that the products may be 50 deg or more below the surrounding air temperature.

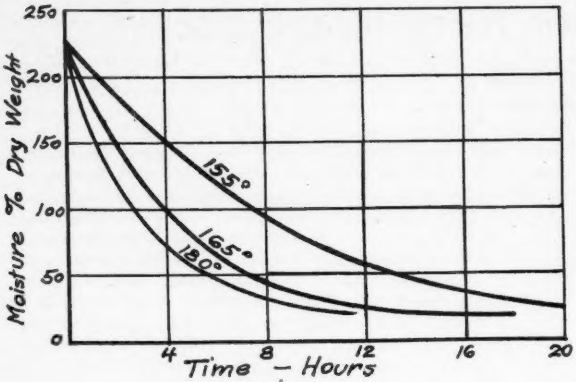
Several factors in the use of thermostats deserve special consideration. C. P. Wagner of Northern States Power Co. calls attention to the fact that thermal controls will not control air temperatures even in strong air currents if they are placed so they can get any direct radiation from the heating elements. Miss Lenore E. Sater of the U. S. Department of Agriculture has found that, in the presence of moisture, bimetallic thermostats in dehydrators or ovens will give increasing temperatures as the heating progresses.

I have proposed to several designers that they devise a heat control which would be governed by the temperature of the food rather than the air. It would give a semiwet-bulb temperature. The control could then be set for the maximum permissible temperature for the food being dried, a high wattage provided at the start, and the control — high air temperature at first and lower toward the end — would be automatic.

High air velocity across the trays will help in maintaining uniform air temperatures within the drier where the air is depended upon to convey the heat to the food. Reasonably high air velocities, if evenly distributed over the different trays, should give more uniform drying and save the shifting and turning of trays. In preliminary studies of small dehydrators it appears that more uniform airflow over all the trays is obtained when some static pressure, even though it is small, is built up in a plenum chamber just in front of the trays.

Paper presented at the annual meeting of the American Society of Agricultural Engineers at Lafayette, Indiana, June, 1943. A contribution of the Rural Electric Division.

GEO. W. KABLE is editor, Electricity on the Farm.



Typical drying curves

The matter of safety from fire and protection of fan motors, particulary in homemade driers, has not been given adequate consideration in all cases. W. C. Krueger, extension agricultural engineer for New Jersey, suggests using a fusetron inside the cabinet as an added precaution against sticking or failure of thermostats. Where heat is intense, asbestos linings of heat chambers should be provided. There is also some question whether ordinary household fan motors will long stand the heat inside a dehydrator. In many models some motor cooling is provided by directing the incoming fresh air over the motor. The General Electric Company has designed a special motor and heating unit for the purpose. Probably few homemade driers would pass Underwriters inspection. Safety should not be entirely overlooked in the rush of getting into the field. We have no houses to lose now.

There is wide difference in the extent and methods of venting small dehydrators for removing moisture. Some recirculation types have very small intakes and outtakes and will just about operate on air leakage with the vents closed. Others have no recirculation and all the air moves in, over the food, and out.

The cost of operating will depend upon the intelligence used in operation, the insulation, the amount of recirculation, other features of design, and the interest on investment and depreciation on the equipment. It is my personal opinion that the actual cost of electricity used for home drying will be relatively unimportant in comparison with the labor involved in processing and the first cost of the equipment.

Insulation may serve a more important function than reduction of operating cost in enabling higher temperatures to be used within the limits of outlet and house-wiring capacities. Time of drying will be important as it may take the housewife a half day to prepare and process the foods, and a 10 or 12-hr drying period beyond that would run her labor far into the night.

Tray design varies widely. Some are of solid glass or vitreous enameled steel. Others are solid wood, wood slats, wood frames with wire screen bottoms, and some have twine supported cloth tray bottoms. At least one commercial dehydrator is of a design that requires solid bottom trays to direct the air flow. In most dehydrators using forced air circulation, the solid trays give about the same results as screen bottom trays. Some products like sliced apples or spinach stick to solid trays so it is almost impossible to get them off in good condition. To prevent this, cloth may be laid over the solid bottom. Glass and enameled trays are easy to keep sanitary. Galvanized wire screen will eventually rust and have to be covered with cloth, especially if used for sulphuring fruits or for fruits dipped in sulphite solution.

Some excellent tables giving instructions for selection, preparation, preprocessing, temperature regulation, packaging and dehydrating are available in bulletins released within the past few months.

It is probably safe to say that all of the small driers will dry some foods satisfactorily. The most simple and inexpensive one may do a good job if it is properly handled and nursed along. The better designed units will require less experimenting, less attention, and less labor. There will probably be less spoilage with them because some of the desirable conditions will be maintained automatically rather than by constant attention and manual operation.

The small dehydrators in the process of development or for which plans are available are too new to pass judgment on. It would not be possible to give the relative merits of specific designs without first running a season's comparative tests on them. This has not been done. The measure of success will not be theoretical but actual performance in the hands of users.

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(Driers being developed)

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General Bronze Corp., Long Island City, N. Y.

General Electric Co., Bridgeport, Conn. (Small dehydrator; also special fan and heater unit with high-temperature motor)

Lansdowne & Moody, Houston, Texas. (Cabinet with trays to be heated by one 200-watt lamp. No fan. Sells for $5.95 without lamp. Being sold by Sears and Ward in Texas and by Gimbels in New York)

Metropolitan Device Corp. Inc., Brooklyn, N. Y. (Built REA units and have small unit of own design with fan recirculating device and automatic heat control)

Stewart-Warner Corp., Chicago, Ill. (Electric heaters above and below each tray)

Wood Manufacturing Co., Santa Cruz, Calif. (Electric recirculation type)

BULLETINS AVAILABLE

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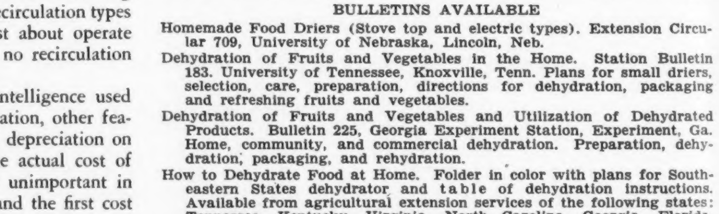

Agricultural engineers (there are at least five of them in this picture) are playing a leading role in the design and development of the small home food dehydrator

Home Dehydrators—Here Today! Gone Tomorrow?

By Lawrence C. Porter
FELLOW A.S.A.E.

PROBABLY no one subject is creating more interest and talk in the home today than the raising and preserving of food. Almost over night there has sprung up a wide interest in the home type dehydrator. Many experimental models have been made, and construction designs and instruction sheets issued. Some of these have been carefully tested in the laboratory by experts who know all the little tricks necessary to success. We wonder what public opinion will be a year from now after Mrs. Jones and Mrs. Brown and Mrs. Black have actually used the home dehydrator.

So far the idea seems to have "just growed", like Topsy, with relatively little ingenuity and not a great deal of research put into the design and construction of units. A year ago at the A.S.A.E. annual meeting one of the colleges showed a dehydrator they had developed. It consisted essentially of a simple box with some cleats nailed to the sides to support trays of food to be dried. On the bottom of the box were nine 100-w mazda lamps to furnish the heat, and on the top was an ordinary household fan to draw the air heated by the lamps up through and over the trays of food, and out at the top. Samples of food that had been dried in this unit were exhibited, and the parade was on! One college after another came out with dehydrator designs. Some were chinese copies of this early unit and some were slightly modified designs. Then several of the electric utilities saw the light and also designed and publicized dehydrators. REA and TVA entered the race and were soon joined by some commercial organizations. A lumber company, for example, placed a unit on the market. A manufacturer of heat insulating board put out a design for a unit to be constructed from their product. And finally some of the large electrical equipment manufacturers entered the field with designs approved at Washington with a promise to release enough material to permit manufacturing and marketing 100,000 units.

Then the flame was fanned when the U. S. Department of Agriculture urged as many people as possible to preserve their surplus garden produce this year; and in the same breath said that non-acid vegetables should not be canned unless you have a pressure cooker, or you might be killed by the deadly botulinum germ; however, you can safeguard against sudden death by dehydrating your vegetables. Pressure cookers, due to war conditions, are as scarce as the proverbial hen's teeth, in spite of the 275,000 that WPB expects to release for use by the 136 million people in the USA. But, according to much publicity, anybody with a hammer, a saw, and a few nails can knock together a dehydrator. In fact, one publication even shows how to make it out of a couple of old apple crates!

Apparently almost anything that generates a little heat can be used in the home type dehydrator. Looking through the various bulletins on the subject we find illustrated and recommended the following heat sources: (1) The portable oil stove, (2) the kitchen range (wood, kerosene, gas, or electric burning), (3) gas hot plates, (4) electric hot plates, (5) electric flat irons, (6) portable electric heaters (with or without fan), (7) ordinary electric light bulbs (100, 200, 250, or 300-w), (8) infrared drying lamps, (9) outdoor sun, (10) oil or electric table lamps, and (11) nichrome or iron wire resistance units.

Dehydrators are recommended both with and without forced ventilation. For forced ventilation anything from the cheapest little 6-in household fan to the 14-in variable-speed oscillating unit have been suggested. As to how long or how well these fans that were designed to operate in open air of perhaps a maximum of 100 F temperature will stand up in the moist air in the dehydrator of from 140 to 165 F, nobody seems to know.

Many of the dehydrator designs show gas-filled electric light bulbs in the bottom of the unit with their tops just a few inches below the bottom tray on which wet fruit and vegetables are placed. The fact that water dropping onto the bulb of a gas-filled lamp is likely to crack it and burn out the lamp, or even cause it to explode, seems in many cases to have been entirely ignored. This danger would be eliminated if carbon filament lamps were used.

Most of the dehydrator designs call for wood construction. Some call for even paper or corrugated board. They do have small adjustable vents, but it would be very easy to have those closed. Then we would have from 900 to 1200 w of electrical energy boxed up in a practically air-tight inflammable box of relatively small dimensions. Would that start a fire? Nobody seems to have taken the trouble to find out. In fact, some dehydrators with wooden legs are shown set on top of open-flame kitchen ranges. That probably is all right—until someone gets careless and puts the leg too near the flame.

Most of the dehydrators have trays which are one or two inches shorter than the length of the cabinet, the idea being that the first tray is pushed all the way back, the second tray is placed against the front, the third against the back, etc. This is to allow the air to circulate over the front end of the first tray, backward across that, over the rear end of the second tray, forward over that, and so on up to the top. Some of the dehydrators have stops placed on tray slides so as to hold the trays in the correct position. This adds to the material and labor of construction.

Furthermore, after the food has begun to shrink air spaces are formed between different pieces of food and the air soon goes up through the trays rather than circulating back and forth across them.

We wonder why no one has suggested building the trays the full length of the dehydrator and then, after they are loaded and before putting them in the unit, pushing the food back a little from the front end of the first tray, back a little from the rear end of the second tray, and so on up, which would accomplish the same purpose, give a little more capacity, and save a little material and labor.

For those who wish to go to the least possible expense and labor to experiment with dehydration before building a carefully made unit requiring considerable carpentering skill, reasonably satisfactory results can be obtained by making a frame to hold the trays and simply placing over it a corrugated paper carton. Three sides of a rectangle are cut out on the top of the carton and the flap bent up as an exhaust vent, and the same can be done at the bottom; or the frame holding the trays can be set up on four blocks to hold the bottom of the carton a little way off the table.

As a matter of fact, it is not even necessary to build a frame in which the trays can be slid in and out. If they are made of simple 2x1 pieces nailed together and have a piece of netting tacked across the bottom, the trays can be stacked one on top of the other.

A corrugated paper carton, of course, is not such a good heat insulator as a carefully made cabinet with commercial heat insulating material. On the other hand, it is a reasonably good heat insulator and can probably be found around the house or easily obtained at the local grocery store. The difference in current consumption between a unit made of good heat insulating material and that made of a corrugated paper carton is so small that the dehydrator would have to be used a long, long time to pay for the additional cost of the heat insulating material and the labor of putting it together.

Some of the dehydrators are shown with cloth bottoms to the trays to support 1 or 1½ lb of vegetables. For example, let us say spinach. Suppose the spinach gets well dried and for one reason or another the cloth support tears or pulls out and drops the dry spinach down onto the heat source. Fire might start.

Wire bottom trays are recommended for holding such things as pears, peaches, potatoes, plums, etc. Unquestionably they will stick to the wire. Cheese cloth spread over the wire is advocated to lessen that difficulty. Even glass trays are used in some cases. How much is the drying slowed up by having the air go only across the product instead of up through and around it as well? If anybody knows, the secret has been well kept. Would plastic netting be better? And if so, where do we get it?

The idea of making the cabinet of heat insulating material to conserve energy is sound, but that adds considerably to the cost

Article prepared especially for AGRICULTURAL ENGINEERING.
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and difficulty of construction. It is stated that about 10 lb of fruit and vegetables can be dehydrated in approximately 8 to 14 hr, depending upon the kind of food. For easy figuring, let us say the dehydrator uses 900 w of electrical energy for 10 hr. That means consuming 9 kw-hr, which at 3c per kw-hr is 27c. The food is supposed to dry at approximately 140 F, and unless the unit is equipped with a thermostat (and most of them are not), the temperature is regulated by unscrewing one or more bulbs and by opening the air intake and outlet wider. Practically, we wonder how closely the temperature will be regulated, and how much of the 27c would be saved by the use of heat insulation. Would it be enough to pay for cost of the material and labor of installation? We wonder.

Speaking of temperature, the fastest drying results when the produce is started at high temperatures, say, 165 F or more, and then reduced as the surface moisture dries. Actually most homemade dehydrators work in reverse. Due to the initially high moisture content of the produce, evaporation keeps them cooler at the start and the temperature in the produce itself rises as drying progresses. A little ingenuity could get around that difficulty in several ways. (1) Enough heat could be used to offset the early surface evaporation and then reduced either manually or by thermostat as drying progresses. (2) Dehydrators could be constructed with high and low temperature compartments and the food trays moved from one to another, or even allowed to fall through graded size openings as it shrivels or shrinks in drying. (3) It should be quite possible to place the food on a slowly moving belt or on rotating trays passing under graded temperature heat sources.

Most of the dehydrator designs so far call for adjustable area intake and outlet openings. Why both? Any air that goes out must also come in. Close either the outlet or the intake and circulation stops, so why not save construction by having only one of the openings adjustable?

Another problem is what to do with the dehydrator when it is not in use. It is just one more big box to stand around somewhere. Apparently no one has yet made a unit consisting of four flat sides, a flat top, and a flat bottom that can be hooked together, or even hinged, so that when the job is finished the unit can be easily disassembled or folded up into a relatively compact unit. In fact, a workable dehydrator could be made simply by suspending several food trays, one under the other, over the heat source and setting a large corrugated paper carton around them to cause most of the heat to go up through the trays.

There have been reports that the use of infrared lamps, particularly the reflector bulb type, results in much faster drying. Dehydrators have been built with several layers of trays, one above the other, and a baffle between the lamps and the bottom tray. Any possible advantage of these more expensive and less available lamps is then lost by cutting off the direct radiation. Even if the baffle were eliminated, the food on the bottom tray would cut off the direct radiation from the trays above and would likely dry too fast or scorch before the warm air dried the food on the upper trays. Under such conditions the only function of the infrared lamps is to heat the air passing over them, and they are no more effective for that purpose than ordinary and less expensive lamps of equal wattage.

If the direct radiation of infrared lamps will dry food much faster than is done by simply passing warm air over it, and provided they don't dry it so fast as to produce case hardening, a single tray of food with R-40 reflector-bulb drying lamps above and below it, or on each side of it, might be enough faster to compensate for the use of a single tray instead of multiple units.

Speaking of lamps, there is no more heat in nine 100-w lamps than in three 300-w lamps, but the former require six more sockets and a corresponding increase in wiring and installation labor. The nine lamps list at $1.35. Three 300-w lamps cost identically the same.

Every available bit of tungsten filament wire is needed for more important jobs of lighting war plants, offices, schools, and homes. The use of carbon filament lamps has these advantages: (1) Saves critical materials; (2) where thermostats are used, carbon lamps do not have the high initial inrush current of tungsten filaments and therefore do not destroy thermostat contact point by arcing; (3) carbon filament lamps have a higher heat and lower light output per watt; (4) the carbon lamp has a long life, and blackening is no detriment for heating purposes, and (5) water dripping onto a carbon lamp is not likely to crack the bulb or even cause it to explode as is almost certain to happen with a gas-filled tungsten filament lamp.

In most of the lamp dehydrators the lamps are placed base down on the bottom, thus increasing the size of the dehydrator unnecessarily. They will operate just as well in horizontal positions and can be staggered to obtain further space saving, having the base of one lamp opposite maximum diameter of the bulb of another.

There seems to be some indication that bright light has a deleterious effect on vitamin C. If it does, why not place the lamps in a section of the dehydrator entirely shielded from the food since their only function is to heat the air blown over them?

The timing of the drying process could be done more easily by the use of a time switch, such as the electric timer used with the household roaster. Even an ordinary dollar alarm clock would be a good reminder for the housewife. If one of the radio clocks is available which will preset any 15-min or longer program, it could be used to regulate the drying temperatures. For example, it might be set for a 4-hr period at the start, then off for 15 min, on for 1 hr, or any other combination which by experiment would be found to give the best results.

Sulphuring certain fruits is recommended in preparing them for dehydration. Sulphuring is a mean job that has to be done out of doors. There is available a solution (developed by the Boyce Thompson Institute for Plant Research, Yonkers, N. Y.) in which the fruit is simply soaked to accomplish the same result as sulphuring. It is much more convenient and not at all expensive. Known as Frulite, it is sold by the Frulite Company, 30 S. Broadway, Yonkers, New York.

Unquestionably the publicity that has been given the homemade dehydrator by and large will result in an overall advantage, and in saving considerable food. There will be some failures, of course, partly due to poorly designed and poorly built equipment, partly due to lack of knowledge regarding the preparation and handling of the food, and partly due to lack of patience to fuss with the process. A great many people will become acquainted for the first time with dehydrated foods. Some of the home product will be very good and some not so good.

Manufacturers of home type dehydrators have a great opportunity to influence considerable postwar business by the end product their units produce. If it is good, the users will develop a liking for dehydrated foods and thus materially increase the market not only for home dehydrated foods but for the commercial product that will be available in quantity after the war. If it is bad, the acceptance by the public and the development of commercial dehydration may be seriously retarded.

We have passed the first flush of a new idea—new at least to the majority of the public. Now is the time to do more careful design work, make more tests, and do further research. By winter the public will have found out what's good and what's bad with the dehydrator designs now available. Our colleges, electric utilities, etc., will do well to gather as much of this service data as possible and be ready next spring with some greatly improved designs of homemade dehydrators; and the same goes for commercial manufacturers of the home type dehydrators.

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(Continued from page 264)

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(Continued on opposite page)

Wartime Rural Electric Service

By Roy E. Hayman

MEMBER A.S.A.E.

PROBABLY the easiest way to start a discussion of the subject of setting up a wartime rural electric service department would be to say "Don't" and then go fishing.

However, in discussing it, it will be necessary that I limit my remarks to the conditions under which our company operates. Please bear in mind that my remarks will be more or less general and should be altered to apply to different situations.

Probably, to be technically accurate, we should define the kind of war for which we are setting up a rural electric service department. I am, therefore, basing my assumption on the fact that we are participants in a global war and that any program that does not bend itself and make all effort towards the winning of this war should not exist; it should not even be discussed.

Recently I visited a branch office of WPB in an attempt to facilitate the approval of priorities to secure some badly needed equipment. The first thing I noticed upon entering the office was a large placard which read, "If It Doesn't Help to Win the War, Forget It." Thus any rural program setup must give first consideration to activities leading to the direct assistance in winning the war and all others become of secondary nature.

With this premise then, I suggest that, first of all, the organization should have an individual well qualified with the interpretation or the ability to make the interpretation of the various limitations and rulings as laid down by the WPB. We may not always agree that these rulings are wise or just, but regardless of this we must realize that the men who write the orders or make the rulings have a much broader picture of the over-all situation than we are permitted to see. We must, therefore, even though we may radically disagree, abide by these rulings both in letter and spirit. If we disagree, there are channels through which we can hoist our disagreement.

Now more than ever, we must be in a position, or place ourselves in the position as rapidly as possible, to be able to inform correctly any individual making a request for information on any electric operation on his farm. This is not easy when we realize that in most of our organizations many of the rural electric service men are now in some branch of the armed forces, and men who know something of the application of electricity and of the farmers' problems are rare indeed. We are confronted not only with the shortage of materials but also a shortage of trained personnel; there is a great need for both, and at times this need becomes very vocal.

One problem is probably common to all, that is, what is the solution of the repair or service problem on customer equipment? This is becoming increasingly important as there is little or no parts in stock to repair equipment, and, in many cases, repair parts are difficult or impossible to get, as qualified repair men have been taken into the armed forces just as our rural service men. Fortunately, we have been pretty well relieved of any necessity of meeting the demands for new line construction. I feel quite sure that this is a very limited or minor problem everywhere. The principal qualification is to be able to say "No" to an extension request, and then to give an explanation to the applicant why the answer must be in the negative. An explanation of the reasons for the limitations, I believe, will be readily accepted by almost everyone, and while he may be disappointed in the refusal of his request in general, he will recognize the justification of the denial. However, for the benefit not only of your own organization but also of those individuals taking the brunt of the criticism in our various war agencies, we should not merely say, "It's a war or government ruling." This is unfair to these men and agencies laboring under a severe handicap, and I fear that if we indulge in this practice of giving answers we will eventually have some dirty linen of our own to clean. We find, therefore, that it is advisable to utilize the best men available for this task.

With respect to the servicing of equipment, while it is true that many sales-service organizations have closed for the duration, this situation is not hopeless by any means. Many expediencies have been worked out, dependent upon the needs of the local situation. In some areas companies and service organizations have, for instance, secured, and are making available on a lend or limited rental basis, motors and some other types of equipment. All of the major manufacturing companies, recognizing the seriousness of the repair situation, have set up rather elaborate service organizations, and in which are men well qualified and experienced to teach the servicing of equipment to recruits of the industry.

We have held several such schools and the results have been rather gratifying. We have found a very satisfactory source of recruits in our state rehabilitation commission. For instance, there is no reason why a man suffering from the handicap of a missing leg could not be just as good and as efficient a repair man on an electric refrigerator or washing machine as if he had two legs. Then there are men of fair mechanical ability, who are approaching or have passed the age of competing in heavy industry with the younger men, who can be recruited, and in many cases have become very satisfactory service or repair men.

Recently we have found it advisable and profitable to assign to one man the sole duty of locating any type electric equipment that is idle, making a complete list of this equipment, giving the age and general condition, the asking price, and the name of the owner. This information, in turn, is supplied through proper channels to possible purchasers. We were greatly surprised at the amount of serviceable equipment that is idle in warehouses, attics, basements, or garages. Thus by locating the equipment and bringing together its owner and a possible purchaser, we have been able to add materially to existing loads on the lines and, in many cases what is more important, supply needed parts of repair equipment in basic producing plants.

The setting up of a rural electric service department is not easy at any time, and the difficulties during wartime are many times multiplied. The solution of this problem in any given locality must be based on the conditions existing and the personnel available. While the difficulties are great and will probably become much worse until victory is won, this problem I believe offers an opportunity to do a worth-while job and one which we can expect remuneration after the war is won and we can again live as normal human beings are supposed to live.

Paper presented at the annual meeting of the American Society of Agricultural Engineers at Purdue University, June, 1943. A contribution of the Rural Electric Division.

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(Continued from opposite page)

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The Paint Situation

By Geo. H. Priest, Jr.
MEMBER A.S.A.E.

IN VIEW of the huge military demands for scarce materials and in view of the limitations placed upon new construction, it is imperative that every effort be made to conserve existing farm structures. Under the WPB Construction Limitation Order L-41, the painting of new construction becomes a part of the cost of the project and as such is subject to the limitations of the order, but the repainting of existing construction comes under the heading of maintenance and repair, upon which there is no limitation.

In spite of the tremendous demands made upon the paint industry in connection with the military program, there is ample production capacity to care for all military and civilian requirements. The paint industry has, of course, experienced some material shortages due to two primary causes: (1) The cutting off of imports of resins from Africa and the Far East, tung oil from China, oiticica oil and castor beans from Brazil, and flaxseed from Argentina, and (2) the diversion of solvents and materials used in making synthetic resins to the manufacture of military explosives.

Until recently, however, there have been no significant changes in paint formulation except that the modern quick-drying interior finishes, which are dependent upon solvents and synthetic resins, have been replaced by finishes which are somewhat slower drying, but otherwise entirely satisfactory.

Because of the inability to maintain the normal supplies of imported drying oils, the industry has become more and more dependent upon the domestic flax crop for its supplies of linseed oil. Our domestic flax crop has been tremendously increased and is estimated by the Crop Reporting Board to yield 53,000,000 bu this year as compared with about 40,000,000 bu a year ago, which, in turn, was 25 per cent more than in 1941.

However, because of the over-all shortage of fats and oils and the necessity not only for replacing imports which have been cut off, but of exporting substantial quantities to our military forces and allies abroad, it has become necessary for the War Food Administration to divert a considerable portion of our domestic crop to edible purposes or for use as a replacement for other industrial oils which are diverted to edible purposes.

Accordingly, paint manufacturers are now limited in their use of oil to 50 per cent of their average consumption for the years 1940 and 1941 to meet all civilian requirements; while in order to effect conservation of the oil that is available the War Production Board has limited the amount (pounds per gallon) which can be used in making paint, establishing maximum quantities for ten different classes of paint for interior and exterior use.

This order, issued June 17, becomes effective July 1st and means that for the duration there will be less oil in paints but that more gallons can be made with the amount of oil which is permitted, while dry powder and paste water paints and the resin-emulsion paints, which are relatively low in oil content, will find an increasing field of usefulness.

Paints made in accordance with provisions of the WPB order have been tested by individual manufacturers, by the National Bureau of Standards, and by the scientific section of the National Paint, Varnish and Lacquer Association, and have been approved by the Office of Price Administration as entirely satisfactory for the purposes for which they are intended.

In common with other industries, the paint industry is here and there faced with problems of transportation and manpower, as well as materials, and it is possible that there will be some difficulty experienced in obtaining linseed oil during the next two or three months until the new crop comes in. However, dealers are generally well stocked and it is believed that the industry will be able to continue to supply adequate quantities of good quality paint for all essential civilian requirements.

The maximum oil content established for exterior paint, for instance, is 3.75 lb per gal as compared with a general average of 5 lb per gal before the change was necessitated. However, by bodying a portion of the linseed oil, it is possible to produce a vehicle consisting approximately of one-third each of raw linseed oil, bodied oil, and thinner which is comparable to the conventional vehicle consisting of approximately 85 per cent oil and 15 per cent thinner. A paint made with this vehicle, containing 3.75 lb of oil per gallon, will have the same consistency and general working properties as a paint containing 5 lb of raw oil.

A statement to the Farm Structures Division at the annual meeting of the American Society of Agricultural Engineers at Lafayette, Ind., June, 1943.

GEO. H. PRIEST, JR. is director, technical field service, National Paint, Varnish and Lacquer Assn.

Wartime Farm Lumber

By C. L. Hamilton
MEMBER A.S.A.E.

AT THE time this country was plunged into war there were four materials that were free — wood, cement, glass, and clay products. The supply of these seemed adequate and they were substituted for critical metals. Wood was the principal substitute material and it has taken the major portion of the substitution load. It was substituted for aluminum in propellers, for steel in construction, and for a thousand other uses. It has been substituted literally from the cradle to the grave for there is a War Production Board order that limits the use of steel in baby carriages and in coffins. Wood was the substitute used.

Wood has now left the free list and has become one of our critical materials. The substitution program and military requirements increased lumber consumption in 1942 to about 40 billion board feet. The 1942 consumption exceeded production by 6 to 7 billion board feet. The excess consumption had to come out of inventories badly depleted all over the country.

Last winter it was estimated that the mills might produce 32 billion board feet during 1943, but the latest reports indicate that probably not more than 29 billion board feet will be produced this year. Several reasons account for the decrease in production but the most important is inadequate labor to supply the mills with logs. There is no satisfactory substitute for an experienced lumberjack.

Just before the war over 5 billion board feet of lumber was used in farm construction. This year probably not more than half of this amount will be available. Both military and civilian construction have decreased considerably this year but there has been a large increase in lumber requirements for boxing and crating. Besides essential civilian needs vast amounts of food, equipment, and other material must be crated for shipment abroad. It is estimated that nearly one-half of this year's lumber production will be required for boxing and crating purposes. Essential manufacturing, construction, and lend-lease needs represent the main competitors for the remaining supply. We now have the greatest lumber scramble, between essential competing interests, that this country has ever experienced. Diversion of lumber to one use takes it away from another that may be equally urgent.

Both the WPB and the War Food Administration recognize the need for lumber and other materials essential to the food production program. Recently the WFA has been authorized to assign a higher preference rating (AA-2) to the extent of 500 million board feet during the third quarter for essential farm lumber. While this rating should provide some relief, it may not be high enough to get lumber in some areas and we must realize that the supply is inadequate to furnish all of the lumber that could be used to advantage in the food program. We must divert the limited supply to the most urgent uses and use lumber substitutes wherever possible.

To relieve the pressure, all non-essential uses of lumber should be stopped. In essential construction, all suitable lumber substitutes such as cement, brick, tile, and composition wallboards or shingles should be used to the fullest extent possible. Recently a number of new types of commercial wallboards with waterproof surfaces have been developed. These materials must be used to conserve lumber, even though they may not provide the quality or the type of construction we would recommend in normal times. Agricultural engineers can contribute greatly by directing or encouraging the proper use of these substitutes. Farmers can also contribute by getting any marketable timber on their farms to sawmills. This is a job that could be done during periods when their full time or labor is not required on food production.

A statement made before the annual meeting of the American Society of Agricultural Engineers at Lafayette, Ind., June 1943.

C. L. HAMILTON is chief, farm buildings section, Farm Machinery and Supplies Division, War Food Administration.

Emergency Methods and Equipment to Meet Wartime Needs

By R. D. Barden

MEMBER A.S.A.E.

WARTIME shortages have confronted the farmer with many problems. We are all well aware of the limitations placed on the manufacturers of new farm equipment by Limitation Order 170, which originally provided 23 per cent of 1940 production, and most of us are also aware of the labor shortage that exists on many farms. This shortage is most acute in industrial areas where farmers have found difficulty in meeting wage competition. This situation coupled with the number of boys from the farm in the armed services has created a severe drain on man power in the agricultural areas of the nation.

The loss of man power on the farm in itself is serious enough, but what we frequently fail to realize is the relationship that exists between labor and equipment on the farm. If we look back a hundred years, we find that about 75 per cent of the population lived on the land; in other words, it took about three people living on the land to provide food and shelter for themselves and one person in town. Today the situation is quite reversed. As a matter of fact, it is doubtful if we have 20 per cent of our population gainfully employed in agriculture. When we consider that the government has asked for increased food production for ourselves and our allies, coupled with the fact that equipment is difficult to obtain, it is little wonder that farmers are interested in homebuilt equipment of various types that may help solve their labor and equipment problems.

It is to be regretted that farmers find it necessary to take their time to build devices for themselves, which normally should be and would be built in quantities by factories with more efficient over-all production. This loss of effort is serious when this country needs the efficient use of all man power available.

If we examine the labor requirements of the average general livestock farm of the north central area of this country, we find that there are two periods of the year when labor requirements are at a peak. These periods are during the conflict of corn cultivation and hay harvest and during the fall with harvesting of corn and other crops. If we can develop methods and devices to lower the peaks in these two periods of the year, we not only provide a more efficient use of labor but we also can materially provide a device for stepping up farm production in a time when more food is needed badly. Until the last few years little change or improvement had been made in methods of handling the hay crop. The fact that so many buck rakes have been built on farms or in neighboring shops is evidence that farmers have long felt the need for some method to save time and eliminate hard work at this period of the year. Methods of handling crops in the growing season as well as the harvest season will do much to meet the present labor and equipment crisis.

If we will examine the labor requirements of the average livestock farm of this country, we find that at least 60 per cent of the total labor required on the farm is used in livestock labor. Rearrangement of farms, livestock handling, and feeding devices are all practical means of reducing heavy labor requirements. How many times do you find yourself doing the same job day in and day out when by a simple change one-half the labor would have been saved? All too often we do the job the same way because we "have always done it that way."

There are many things that can be done to meet the present situation. A few that may be practical under present circumstances are as follows:

1 Encourage more exchange of equipment between neighbors. To make this practical and acceptable to farmers on large equipment we should encourage plans so that the owner goes with the machine. The labor that this exchange takes away from the machine owner's farm should be replaced by the man who rents the machine. Don't ask a man to loan or rent his $1000.00 machine to every Tom, Dick, and Harry that may need it.

2 Assist in establishing fair custom and exchange rates on farm machinery. Many farmers do not know what a fair rate of exchange is, especially on the smaller machines. The A.S.A.E. and many states and counties have worked out suggested rental rate tables.

3 Encourage cooperative ownership of some of the larger types of machines when farms are small and do not justify the investment in all equipment.

4 Encourage more custom purchases of combines, hay balers, and corn pickers by dealers, small farmers, and custom operators. See that custom rates are set high enough to encourage custom operation.

5 Promote work rings among small groups of neighbors. Keep responsibility of ownership identified with the machine so that one person is responsible for the condition of the machine.

6 Develop plans to eliminate duplication of effort. Each year many farmers fit their land for corn or other crops only to have a heavy rain follow, requiring the reworking of the soil. In the case of small farms why not encourage two or three farmers to go together, one to fit and the other to plant immediately. In Ohio this year there were thousands of acres that had to be reworked because of the frequent rains that could have been planted earlier. Some of these corn fields are still unplanted.

7 Encourage the use of combinations of tools up to the practical limit of power used. Many farmers could make a once-over application if they could develop and use hitches suitable for the combination of tools needed.

8 Provide educational help of various types that are in keeping with the present emergency. Several states have developed a "wartime series" of leaflets which are single sheet folded or small bulletins. They are very concise and are written to help solve an individual problem.

In preparation for my presentation at this meeting I asked each state to send me materials that they are using and that they feel are helpful in meeting farmers' problems. (Material arranged in folders by states for inspection during the meeting.)

In compiling this material it was quite evident much time of workers might be saved if some plan of cooperation between states could be developed. For example, nearly all the states have done some work on dehydrators, which must have taken considerable time. I am sure that it did in Ohio. Yet the problems of dehydration in Ohio are similar to those in other states. It will likely be impractical to develop a plan nationally, but it could be done relatively easily in certain areas. Many states produced plans for a baling wire straightener. They all look different, but the principle used in most cases is the same. The problem in straightening baling wire in the East will be the same in the Middle West.

An illustration on the other side of cooperative development is the Midwest Farm Building Plan Service with which we are all familiar, the peanut picker of the South, and the buck rake plans. From January 1 to June 1, 1943, twenty states have bought, in quantities of 50 to 6,500, a total of 29,000 buck rake bulletins printed in Ohio. Several states have asked for permission to reprint the bulletin in their states. This has been granted. Four outside agencies and a Canadian experimental station have also purchased in quantity. In terms of saving of man hours, some plan of development and exchange would be a worthy wartime activity.

Paper presented at the annual meeting of the American Society of Agricultural Engineers at Lafayette, Ind., June, 1943. A contribution of the Power and Machinery Division.

R. D. BARDEN is extension specialist in agricultural engineering, Ohio State University.

EDITOR'S NOTE: The list of educational materials compiled by Mr. Barden and referred to in his paper, is available in mimeograph form, and single copies will be mailed to A.S.A.E. members on request to Society headquarters.

Preventing Rust in Farm Machinery

By R. H. Wileman
MEMBER A.S.A.E.

THE MEANS of preventing rust in farm machinery is primarily of two types; namely, (1) the use of paint to prevent the metal from rusting, and (2) the use of grease or some similar material to prevent rusting of polished metal parts or where paint is quickly worn off. These parts quickly rust when not in use and if rusted cause rapid deterioration and no small amount of trouble when the machine is again placed in use.

I will limit my remarks to the second type of rust prevention, except to say that keeping surfaces of farm machines, not subjected to excessive wear, well painted not only increases the life or sale value of the machine, but also has a marked psychological effect on the operator. It is only natural that we would rather use and consequently will take better care of a well-painted machine than we will a rusty one.

From the standpoint of actual loss in time and cash, undoubtedly the neglect of polished surfaces or parts where paint is quickly worn off is the owner's or operator's worst offense. Such parts as plow bottoms, cultivator shovels, corn planter runners, disk blades, etc., are good examples. For protecting such surfaces a material that will give good protection from one season to the next, yet that can be easily removed, is needed. Outside grain elevators are another example where such a material could be used to advantage.

Various oils and greases common on the farm have been used for this purpose with varying degrees of success depending largely on storage conditions. Far too large a percentage of machines on farms receive no rust preventive treatment whatever. Special greases have been developed by the petroleum industry for the prevention of rust on metal parts. These materials were developed and have been used primarily by industry. However, their use by farmers seems to have good possibilities. Greases having a lime or aluminum base are superior to soda-base greases because of the solubility of the soda in water.

Tests comparing the effectiveness of these special rust prevention greases with ordinary oils and greases common on the farm are being conducted. Our tests at the Purdue University Agricutural Experiment Station were started on February 11 (1943). Two kinds of rustproof compounds were used and are being compared with the following oils and greases commonly found on the farm: SAE-140 transmission grease, SAE-30 motor oil, SAE-30 crankcase oil, two kinds of medium pressure gun grease, medium cup grease, axle grease, and medium wheel-bearing grease.

Observations of these oils and greases indicate that they deteriorate in three ways, as follows:

1 The transmission oil and the pressure gun grease checks.

2 The motor oil, crankcase oil, axle grease, and wheel-bearing grease chalk, and the cup grease flakes off.

3 The various greases and oils failed and rusting started in the order named: SAE-30 motor oil, axle grease, SAE-30 crankcase oil, wheel-bearing grease, and cup grease. No rusting has occurred as yet where the pressure gun grease or transmission grease were used; however, these coatings are badly checked. There is no indication yet of failure where either kind of special rust prevention grease was used.

Paper presented at the annual meeting of the American Society of Agricultural Engineers at Lafayette, Ind., June, 1943. A contribution of the Power and Machinery Division.

R. H. WILEMAN is assistant professor of agricultural engineering, Purdue University.

Farm Storage of Soybeans

By Deane G. Carter
FELLOW A.S.A.E.

THE storage of soybeans on the farm was made the subject of a research study in the emergency grain storage in Illinois in 1942. It promises to become one of the most complex of the storage problems.

There has been no farm storage of any consequence, since heretofore the commercial storages and processing plants have been able to handle the crop at the time of harvest. Thus there have been no farm soybean storage structures and data are lacking on the problem.

Our research program is in its second year only and definite conclusions are not justified. Yet the need and the interest in the subject demands that the problem be stated and general recommendations made.

The factors involved in soybean storage may be noted as follows:

1 The market value and the strategic importance of soybeans ranks this crop near the top of the list in wartime importance and therefore justifies unusual attention to storage.

2 The soybean is susceptible to severe damage under unfavorable conditions, especially from excess moisture.

3 Beans are harvested relatively late in the season, when climatic conditions are often unfavorable. Straw and grain may be high in moisture and freezing may occur before the beans are mature. There are many instances when beans are harvested with from 13 to 20 per cent moisture.

4 The typical farm does not have the bin space or the equipment necessary for turning, moving, and drying.

With these problems in mind, it is possible to present the best available recommendations based upon experience, observation, and limited research as follows:

1 Structural requirements are identical with those for shelled corn and wheat. Bushel weights are the same, and there is no indication that any important differences occur in pressures.

2 Soybeans that are mature at harvest and that have moisture contents of 13 per cent or less can be stored with minimum danger of damage.

3 Soybeans deteriorate rapidly when wet, therefore bins must exclude moisture from rain, snow, or seepage.

4 Soybeans with moisture above 13 per cent, possibly up to 16 per cent, can be stored during the winter season where temperatures are usually low. At these moistures, however, the rise in temperature in the early spring will likely cause a lowering in grade and quality, if not a severe loss.

5 Ordinary ventilation cannot be depended upon to reduce moistures. There is likely to be some redistribution of moisture within the bin, and it is entirely possible that bins will acquire moisture over winter.

6 Insects are not likely to cause damage in the first year of storage if the beans are kept dry.

It should be emphasized that additional research is necessary to answer the questions of indefinite storage, fumigation, critical moistures, and storage effects on germination, grade, and fat acidity.

Paper presented at the fall meeting of the American Society of Agricultural Engineers at Chicago, Ill., December, 1942. A contribution of the Farm Structures Division.

DEANE G. CARTER is professor of agricultural engineering, University of Illinois.

Building Needs on American Farms

THE NEED for adequate houses and service buildings on American farms is of great importance. To judge this need realistically, one must consider minimum requirements for decent living and the efficiency of the farm for increased food production and storage, as well as keeping farm building values in line with good business.

Three things must be done to put farm homes and buildings in good condition and keep them so: (1) Normal depreciation must be offset; (2) twenty years' accumulated deficiency in maintenance must be made up, and (3) sub-standard homes and buildings must be modernized, remodeled, or replaced. To do this will require, at a conservative estimate, the expenditure of one billion dollars annually for many years to come.

NEWS SECTION

A.S.A.E. Meetings Calendar

September 27 and 28 — North Atlantic Section, Belmont-Plaza Hotel, New York City.

December 6 to 8—Fall meeting, La Salle Hotel, Chicago, Illinois.

North Atlantic Section Meeting

PLANS shaping up for the meeting of the North Atlantic Section of the American Society of Agricultural Engineers, to be held at the Belmont-Plaza Hotel, New York City, September 27 and 28, provide a generous allotment of time for discussion of requirements and programs of such wartime federal agencies as the War Production Board, War Food Administration, etc., as they affect the interests and activities of agricultural engineers, and likewise the interests of farmers and manufacturers of farm equipment of all kinds. Representatives of the federal agencies will be in attendance at the meeting to exchange views with representatives of industry, of state agencies, etc., on the big problem currently of concern to all, namely, to maintain and provide adequately the tools of production (machines, equipment, structures) needed to attain the highest possible peak of efficiency on America's food production front.

In order to conserve the time of those attending the meeting as much as possible, the regular Section dinner will be held at noon of the first day of the meeting, Monday, September 27, to permit devoting the evening of that day entirely to the four round-table sessions — Power and Machinery, Farm Structures, Rural Electrification, and Soil and Water — that have always been a feature of the meetings of the North Atlantic Section.

Agricultural Engineers in "Essential Occupation"

ACCORDING to an Associated Press dispatch from Washington, dated July 29th, "agricultural engineers" are included among 23 additions in the list of occupations essential to the war effort, as announced by the War Manpower Commission. In making this announcement, however, WMC emphasizes that this action will not compel local boards to defer from military service men engaged in such occupations. The listing is only issued as a guide to local boards in consideration of occupational deferment. Boards may defer men in other unlisted occupations and draft men not considered "necessary" in the essential occupations. This boils down to mean that, as before, the local draft boards, subject to appeal, decide who is going and who isn't, regardless of a man's occupation.

Of further interest to agriculture is the fact that "automotive or agricultural machinery repair parts specialists" are also included among the recent additions to the list of essential occupations.

PART OF WASHINGTON GROUP AT A.S.A.E. MEETING

Special wartime government agencies in Washington concerned with food production and conservation were well represented at the A.S.A.E. annual meeting at Lafayette, Ind., in June. In this group (all members of A.S.A.E., except one) are (left to right) Elmer McCormick, consultant, farm machinery branch, WPB; C. D. Kinsman, head engineer, farm machinery branch, WPB; George Krieger, director, farm machinery branch, WPB; D. A. Milligan, consultant, farm machinery branch, WPB; L. L. Needler, chief, distribution of farm supplies, WFA; R. M. Merrill, consultant on farm equipment, WFA; H. S. Pringle, chief of repairs and maintenance, farm machinery branch, WPB; A. A. Stone, chief, farm equipment and tractor section, OPA; C. L. Hamilton, chief, farm buildings section, WFA; E. L. Arnold, technical adviser, farm machinery branch, WPB

Nominations for A.S.A.E. Medal Awards

IN accord with the rules governing the award of the John Deere and Cyrus Hall McCormick gold medals, the Jury of Awards of the American Society of Agricultural Engineers will receive from members of the Society, up to November 1, nominations of candidates for these two awards for the next year.

Members of the Society nominating candidates for either award are requested to keep in mind the purposes of each medal and formulate their nominations accordingly. The John Deere medal is awarded for "distinguished achievement in the application of science and art to the soil," which citation is interpreted to cover more than a mechanistic concept of engineering, and to include chemistry, physics, biology, and any other science and art involving the soil, the "application" being acceptable to "evaluation by the engineering criteria of practicality and economic advantage."

The Cyrus Hall McCormick medal is awarded "for exceptional and meritorious achievements of a continuing career or to any single item of engineering achievement, and to apply equally to all special fields and types of engineering in agriculture."

The Jury of Awards desires that members of the Society consider it their duty and obligation to give serious thought to the matter and nominate for either or each of these awards the men they believe to be most worthy of the honor. Each nomination must be accompanied by a statement of the reasons for nominating the candidate and the qualifications of the nominee, including his training, experience, contributions to the field of agriculture, a bibliography of his published writings, and any further information which might be useful to the Jury in its deliberations.

The Jury will accept and consider nominations received on or before October 1, and these nominations should be addressed directly to the Secretary of the Society at Saint Joseph, Michigan. The Secretary will supply on request a standard set of instructions for preparing information in support of nominees for the Society's gold medal awards; it is important that these instructions be followed in preparing material on behalf of any nominee.

RESEARCH NOTES

(A.S.A.E. members and friends are invited to supply, for publication under this heading, brief news notes and reports on research activities of special agricultural engineering interest, whether of federal or state agencies or of manufacturing and service organizations. This may include announcements of new projects, concise progress reports giving new and timely data, etc. Address: Editor, AGRICULTURAL ENGINEERING, St. Joseph, Mich.)

Applicants for Membership

The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Austin A. Armer, agricultural engineer, The Spreckles Sugar Co. (Mail) 15 Oak Ave., Davis, Calif.

Dale K. Bee, rural representative, Cincinnati Gas & Electric Co. (Mail) 306 N. Main St., Bethel, Ohio.

Dan E. Cass, assistant conservationist, Soil Conservation Service (Elm Creek-Midland District), U. S. Department of Agriculture. (Mail) Miller, S. D.

George G. Connor, manager, miscellaneous farm supplies div., Pennsylvania Farm Bureau Coop. Assn. (Mail) 2700 Derry St., Harrisburg, Pa.

Bernard G. DeWeese, director, farm management, Union Central Life Insurance Co. (Mail) 3875 Oak St., Mariemont, Cincinnati, Ohio.

Henry C. French, chief engineer and director, Arnold Dryer Co. (Mail) Elm Grove, Wis.

Walter E. Gross, rural service engineer, Pennsylvania Power Co., 19 E. Washington St., New Castle, Pa.

Carl E. Jeerings, manager, farm service div., Rochester Gas & Electric Co. (Mail) Walworth, N. Y.

A. V. Motsinger, associate chemical engineer, Edgewood Arsenal, U. S. War Department. (Mail) P. O. Box 405, Aberdeen, Md.

Charles R. Parrott, production specialist Columbian Steel Tank Co. (Mail) No. RR 2, Parkville, Mo.

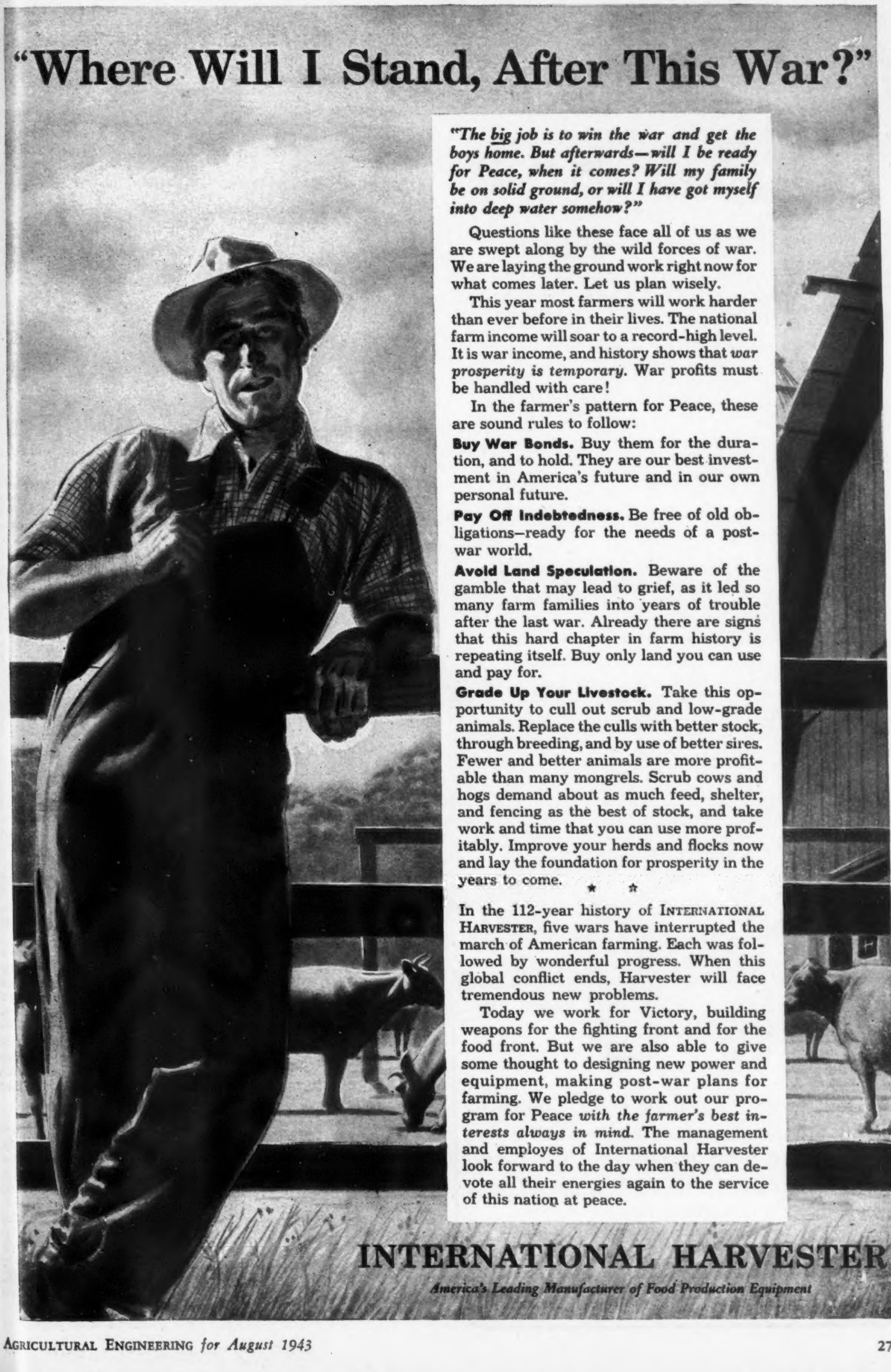
Erwin W. Saiberlich, chief engineer, treasurer, and purchasing agent, Fox River Tractor Co., Appleton, Wis. (Mail) 937 Winnebago St.

Robert M. Salter, chief, Bureau of Plant Industry, Soils, and Agricultural Engineering, (ARA), U. S. Department of Agriculture. (Mail) U. S. Plant Industry Station, Beltsville, Md.

Donald K. Tressler, director of food research, General Electric Co. (Mail) Stonybrook Rd., Westport, Conn.

Perry W. Williamson, district sales manager, general products div., Tokheim Oil Tank & Pump Co., 1600 Wabash Ave., Fort Wayne, Ind.

"Where Will I Stand, After This War?"



"The big job is to win the war and get the boys home. But afterwards—will I be ready for Peace, when it comes? Will my family be on solid ground, or will I have got myself into deep water somehow?"

Questions like these face all of us as we are swept along by the wild forces of war. We are laying the ground work right now for what comes later. Let us plan wisely.

This year most farmers will work harder than ever before in their lives. The national farm income will soar to a record-high level. It is war income, and history shows that *war prosperity is temporary.* War profits must be handled with care!

In the farmer's pattern for Peace, these are sound rules to follow:

Buy War Bonds. Buy them for the duration, and to hold. They are our best investment in America's future and in our own personal future.

Pay Off Indebtedness. Be free of old obligations—ready for the needs of a post-war world.

Avoid Land Speculation. Beware of the gamble that may lead to grief, as it led so many farm families into years of trouble after the last war. Already there are signs that this hard chapter in farm history is repeating itself. Buy only land you can use and pay for.

Grade Up Your Livestock. Take this opportunity to cull out scrub and low-grade animals. Replace the culls with better stock, through breeding, and by use of better sires. Fewer and better animals are more profitable than many mongrels. Scrub cows and hogs demand about as much feed, shelter, and fencing as the best of stock, and take work and time that you can use more profitably. Improve your herds and flocks now and lay the foundation for prosperity in the years to come.

* *

In the 112-year history of INTERNATIONAL HARVESTER, five wars have interrupted the march of American farming. Each was followed by wonderful progress. When this global conflict ends, Harvester will face tremendous new problems.

Today we work for Victory, building weapons for the fighting front and for the food front. But we are also able to give some thought to designing new power and equipment, making post-war plans for farming. We pledge to work out our program for Peace *with the farmer's best interests always in mind.* The management and employes of International Harvester look forward to the day when they can devote all their energies again to the service of this nation at peace.

INTERNATIONAL HARVESTER

America's Leading Manufacturer of Food Production Equipment

Agricultural Engineering Digest

A review of current literature by R. W. TRULLINGER, assistant chief, Office of Experiment Stations, U. S. Department of Agriculture. Copies of publications reviewed may be procured only from the publishers at the address indicated.

HOMEMADE EGG COOLERS. Miss. Ag. Exp. Sta. (State College), Rpt. 1941. Incomplete experiments with a wet burlap egg cooler as compared with other methods of cooling or holding are mentioned.

ABSORPTIVE FORM LINING, *E. N. Vidal and R. F. Blanks*. Jour. Amer. Concrete Inst. (Detroit, Mich.) 13 (1942), No. 3. The authors describe briefly laboratory investigations of the use of the wallboard type of absorptive form lining, field tests to determine the practicability of the method, purchase specifications, and experiences in using absorptive form lining in actual construction.

SMALL ELECTRICALLY OPERATED CROSSCUT SAW, *H. L. Garver and P. G. May*. U. S. Dept. Agr. (Washington) Bur. Agr. Chem. and Engin. (1941) ACE-114. A crosscut saw operated by a ¼-hp motor and satisfactory for logs of diameters up to 15 in is described. Working drawings, bill of materials, assembly directions, and photographs accompany the brief descriptive text. The cost of this outfit, including the ¼-hp motor, was approximately $25. It will cut wood as fast as two men with a crosscut saw and at the same time permit the operator to handle the logs and toss away the billets.

AN INEXPENSIVE LAYING-HOUSE FLOOR OF WIRE SUPPORTED BY PEELED PINE POLES, *H. D. Polk*. Miss. Ag. Exp. Sta. (State College) Farm Res. 5 (1942). No. 2. The author describes briefly the construction of the type of floor named for a house 12 by 24 ft, emphasizing that such a floor should lie 18 in at least above the ground level. He also points out that 16-gage, 1-in mesh netting should have more than double the durability of the cheaper and more commonly available 20-gage netting, and the bill of materials given calls for the heavier wire for the flooring. A cost, exclusive of the labor cost for cutting and preparing poles and laying the floor, of $8.23 is estimated.

MANUAL OF FARM SHOP PRACTICE, *M. M. Jones*. McGraw-Hill Book Co. (New York), 1940. This manual consists of plans for devices and appliances that may be made in the farm shop or the school shop, selected mainly because of their value in helping students to learn the fundamental shop processes and because of the usefulness or value of the jobs when done. At the end of each job outline are given references, by chapter and paragraph number for each of the basic processes involved, to the author's textbook, Farm Shop Practice.

SURFACE WATER SUPPLY OF THE UNITED STATES, 1938, part 2; 1939, parts 5, 10; 1940, parts 11, 12. U. S. Geol. Survey (Washington), Water-Supply Papers 852 (1940), 875 (1941), 880 (1941), 901 (1941), 902 (1941). These papers record measurements of stream flow, No. 852 covering the South Atlantic slope and eastern Gulf of Mexico Basins, for the year ended September 30, 1938; No. 875 the Hudson Bay and upper Mississippi River Basins and No. 880 the Great Basin for the year ended September 30, 1939; and 901 covering the Pacific slope basins in California and 902 the Pacific slope basins in Washington and upper Columbia River Basin, for the year ended September 30, 1940.

REPORT OF THE ADMINISTRATOR OF THE RURAL ELECTRIFICATION ADMINISTRATION, *H. Slattery*. U. S. Dept. Agr. (Washington). Rural Elec. Admin. Rpt., 1941. On December 31, 1934, about 4 months before the Administration was established, 10.9 per cent of American farms had central-station electric service. At the end of the fiscal year 1941 this figure had risen to 34.9 per cent. This report details the normal operations of the fiscal year 1941, briefly notes the place of the Administration in the national defense program, takes up legal aspects of rural electrification, and summarizes the current fiscal status of REA borrowers. An appendix tabulates data concerning progress of current activities.

ENCOURAGEMENT OF CEREAL GRAIN PRODUCTION BY MEANS OF THE COMBINE HARVESTER AND THE HAMMER MILL. Maine Ag. Exp. Sta. (Orono), Bul. 405 (1941). Primary obstacles in the way of increased cereal grain production in northern New England, namely, rain and wet weather at harvest time and wet weather delaying the harvest of cereals to a time when the potato harvest starts, may be overcome by means of the combine harvester. Using such a machine at the station's Aroostook farm, two men are able to bring in a harvest of bagged grain from the field without the weather hazard and time-loss and interference associated with shocking, stacking, and threshing when each operation is separate. Locally distributed hammer mills would also encourage cereal grain production.

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The Nebraska Tractor Tests, 1920-1941. Nebraska Ag. Exp. Sta. (Lincoln) Bul. 338 (1942). This bulletin extends the record noted in previous years to include the results of the 1941 tests.

The Installation and Use of Attic Fans, *W. H. Badgett.* Tex. Engin. Expt. Sta. (College Station), Bul. 52 (1940). Selection and mounting of an adequate fan, construction of ceiling grilles, suction boxes, louvers, hooded and louvered penthouses, automatic shutters, etc., are presented in detail with working drawings, diagrams, photographs, and the performance curves of a 42-in fan.

Agricultural Engineering Investigations by the Iowa Station. Iowa Ag. Exp. Sta. (Ames) Rpt. 1941. This report contains in part 1, brief notes on an investigation of farm building losses due to wind and fire, utilization of clay products, plywood, steel, and lumber in farm building construction, atmospheric exposure tests of wire and fencing, and farm fence construction, all by H. Giese; agricultural engineering service, by J. B. Davidson; utilization of agricultural wastes for farm building insulation, by H. J. Barre; efficiency and economy of pneumatic tires for transport wheels on agricultural equipment, by E. G. McKibben; and labor, power, and equipment requirements of various methods of harvesting, transporting, processing, and storing hay, and of storage, treatment, transportation, and distribution of dairy barn manure, both by Davidson and McKibben.

In part 2, under the general caption methods and equipment for seedbed preparation, planting, cultivating, and harvesting (of corn), efficiency of corn pickers, seedbed preparation for corn, and corn production methods and equipment are noted by C. K. Shedd, Davidson, and E. V. Collins; and hill spacing of check planted corn, by Collins, Davidson, Shedd, and G. F. Sprague. Under the caption methods, equipment, and buildings for curing and storage of corn, the storage and curing of corn is reported upon by Barre, Davidson, and J. L. Robinson; and investigation of farm storage of corn, by Davidson and G. Semeniuk.

Saving Steel in Reinforced Concrete Design, *R. L. Bertin.* Jour. Amer. Concrete Inst. (Detroit, Mich.) 13 (1942), No. 4. The author proposes the prompt modification of the institute's Building Regulations for Reinforced Concrete, with reference especially to emergency construction for temporary use. He outlines a proposed emergency code and sums up its principles with respect to steel conservation as follows: "(1) Let the concrete do all the work it is capable of doing, (2) such reinforcement as is used should be high yield point steel, and (3) liberalize the working stresses to an extent consistent with a safe but not excessive factor of safety."

Farm Shop Practice, *M. M. Jones.* McGraw-Hill Book Co. (New York), 1939. The author points out that it is recognized more and more that for satisfactory achievement in shop work the student must study the subject systematically as well as work with his hands on practical jobs or projects in the shop. The book is planned to permit all possible flexibility in its use. It treats tools and tool processes separately and apart from any particular set of jobs or projects. It can be used, therefore, in connection with any jobs that meet particular local needs.

Following brief prefatory statements, Part 1, dealing with farm woodwork and carpentry, contains chapters on measuring and marking; sawing; planing and smoothing; wood chisels and their use; boring and drilling holes in wood; wood fastenings; use of modeling or forming tools — shaping curved and irregular surfaces; painting, finishing, glazing; and cutting common rafters. Part 2, taking up tool sharpening and fitting, consists of chapters on tool sharpening, grinding and sharpening equipment, and saw sharpening. Part 3, on cold-metal work, presents the topics general bench and vise work, drilling tools and their use, and bolt-threading equipment and its use. Part 4 consists of a single chapter on pipework on the farm and part 5 deals similarly with soldering and sheet-metal work. Part 6, presenting the subject of farm blacksmithing, covers blacksmithing equipment — forge fires; fundamental forging operations; forging and tempering tool steel; and welding, plow sharpening — kinds of iron and steel. Part 7 deals in one chapter with farm concrete work. Part 8, harness, belt, and rope work, has the chapters harness repair, belting, belt lacing; and rope work. A subject index concludes the book.

The 1944 Farm Machinery Program

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made subject to distribution by the War Food Administration, has worked rather satisfactorily under the 1943 program, and it is contemplated that under the 1944 program, this principle may be more widely used.

The volume of machinery and supplies that will be available for purchase in 1944 will be only a fraction of the consumptive demand. It will doubtless, therefore, be necessary to ration all important types of equipment to individual farmers.

It would probably be unwise to provide a distribution program that might be found inadequate as the season advances. It is less difficult to relax control than it is to assume control, after distribution has begun. The War Food Administration will probably therefore take the precaution of announcing a fairly strict plan and liberalize it as conditions may justify. There is no desire to exercise control which serves no useful purpose in the food production program. Those who are familiar with the attitude of the War Food Administration during the past several months certainly realize that this has been the policy until this time, and we see no reason now to change that policy.

EMPLOYMENT BULLETIN

The American Society of Agricultural Engineers conducts an employment service especially for the benefit of its members. Only Society members in good standing may insert notices under "Positions Wanted," or apply for positions under "Positions Open." Both non-members and members seeking to fill positions, for which ASAE members are qualified, are privileged to insert notices under "Positions Open," and to be referred to members listed under "Positions Wanted." Any notice in this bulletin will be inserted once and will thereafter be discontinued, unless additional insertions are requested. There is no charge for notices published in this bulletin. Requests for insertions should be addressed to ASAE, St. Joseph, Michigan.

POSITIONS OPEN

RESEARCH ENGINEER in electroagriculture wanted at The Pennsylvania State College, Department of Agricultural Engineering, State College, preferably a young graduate engineer vitally interested in research where engineering fundamentals are applied to problems in agriculture. The program includes research in freezing, cooling, and heating; illumination as applied to biological, physiological, and bacteriological studies; dehydration; use of power, as well as electronics.

AGRICULTURAL ENGINEER to teach farm shop, farm engines, and soil erosion control, in a southern college. Salary up to $2700, depending upon qualifications. Persons interested may submit full particulars regarding training and experience to PO-142.

RESEARCH ENGINEER wanted for design and development of agricultural machinery and equipment for the Southeast. Salary up to $3,000, depending on qualifications. Persons interested are requested to write giving full particulars regarding training, experience, and other pertinent information. PO-141.

POSITIONS WANTED

AGRICULTURAL ENGINEER, B. S. degree, for many years head of an agricultural engineering department in a land-grant university supervising and carrying on teaching, extension, and research work, seeks opening in college or industry, permanently or for the duration. Has had broad experience in farm buildings, drainage, soil conservation, and farm machinery and power. Special applications of machinery for dairy, vegetables, and fruit. Farm shop experience. Above draft age. PW-355

RESEARCH ENGINEER available (B. S. 1933, M. S. in Agr. 1934, Agr'l. Engr. 1839), with engineering license to practice. Nine years of employment with a state college, two private power companies, two federal bureaus, and head of a field office for a federal commission with classified experience in electrical engineering, agricultural engineering, utilization, and industrial relations. Thirty-two years of age, married, two children. Available at a salary range from $3200.00 to $5000.00 depending upon location, employer, and business policies. PW-354

AGRICULTURAL ENGINEER, graduate in agriculture and mechanical engineering from Ohio State University. Major field of training in machinery and power, with broad experience in structures and conservation as well; considerable experience in planning, developing, and administrative activities; at present director of division of agriculture in private institution but desires change of location. Available September 1st. PW-353

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